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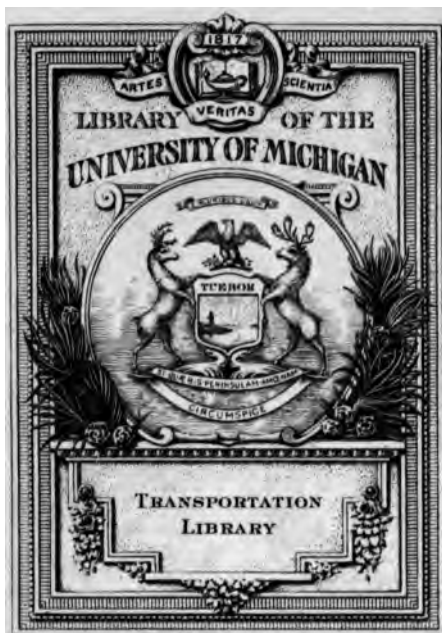
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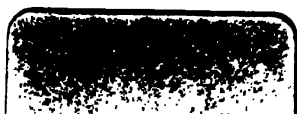
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INTERSTATE COMMERCE AND RAILWAY TRAFFIC COURSE

Prepared under Editorial Supervision of
Samuel MacClintock, Ph.D.

The subjects listed below constitute the basic material of a course in Interstate Commerce and Railway Traffic. This course is especially designed to meet the constantly growing demand for efficiently trained men in railroad and industrial traffic work; to assist students to pass the examinations for government service under the Interstate Commerce Commission; and to meet the demand for men competent to direct the work of commercial organizations and traffic bureaus. With the exception of the Atlas of Railway Traffic Maps, the subjects listed below are covered in an average of approximately 200 pages each.

Atlas of Railway Traffic Maps
Traffic Glossary
Freight Classification; Some Ways of Reducing Freight Charges
Freight Rates: Western Territory; Bases for Freight Charges
Freight Rates: Official Classification Territory and Eastern Canada; Industrial Traffic Department
Freight Rates: Southern Territory
Publication and Filing of Tariffs
Freight Claims; Investigation of Freight Claims;
Routing Freight Shipments; The Bill of Lading;
A Primary Lesson in Transit; Demurrage
Railway Organization; Statistics of Freight Traffic;
Railway Accounting
Express and Parcel Post
Ocean Traffic and Trade
Railway Regulation
The Act to Regulate Commerce and Supplemental Acts
Conference Rulings; Procedure Before the Interstate Commerce Commission; Grounds of Proof in Rate Cases
Application of Tariffs
The Law of Carriers of Goods
Practical Traffic Problems

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RAILWAY ORGANIZATION AND MANAGEMENT

JAMES PEABODY

Late Statistician

Atchison, Topeka & Santa Fe Railway Company



La Salle Extension University

- Chicago -

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PREFACE

The object of this work is to summarize the organization and management of representative transportation companies of this country; to illustrate the activities of the various departments; and to show their relationship to one another in such a way as to make plain to the student of transportation, and the layman as well, the system underlying the efficient conduct of these properties.

As the work is one of a series dealing with interstate commerce and railway traffic, the activities of the traffic department have been more fully shown than those of the operating and accounting departments.

In the preparation of the work the author gratefully acknowledges the assistance and criticism of Professor Ernest Ritson Dewsnup of the University of Illinois, Mr. Mark Wymond of the Central Freight Association, and Mr. Ralph Edgar Riley of the LaSalle Extension University.

J. P.

RAILWAY ORGANIZATION AND MANAGEMENT

CHAPTER I

INTRODUCTION

Aside from religion and education, transportation is the greatest work of the age and as such is attracting the attention of the greatest men of the age. Next to religion and the public school, effective transportation has had much more to do with the civilization of the world than any other one thing. Of all industries, agriculture alone excepted, transportation employs the greatest number of people. It is estimated that in North America it involves, directly or indirectly, the services of one out of every sixteen of the inhabitants.

The prosperity of this country is intimately allied with the prosperity of the transportation industry. Statistics prove that the years of the greatest railroad earnings are reflected by the greatest mercantile and industrial earnings. As a matter of fact the transportation systems of this country are auxiliaries of the business they serve, and accordingly the far-seeing business man recognizes them as *his* railroads or *his* transportation systems and is chary of doing anything or of having anything done that may impair their efficiency, for to the extent that this is done his business suffers.

The successful manufacture of goods is contingent on drawing crude or unfinished products into the plant, converting them into the finished product, and distributing them for sale in the widest possible area.

2 RAILWAY ORGANIZATION AND MANAGEMENT

Practically everything, to have value, must be transported from places where it is plentiful to points where it is in demand, and the plan by which this is consummated hinges on railroad organization and management.

The development of these organizations has been summed up by one writer in a very concise manner as follows:

The early railroads were rarely more than one or two hundred miles long. The officer responsible for maintenance and operation was personally familiar with every mile of track, the characteristics of every locomotive, and of almost every employee on the payroll. By continual travel over the road and incessant supervision this officer, the man immediately responsible to the owners of the road, could immediately direct the application of material and the performance of the employees. As many of the roads were extended and as there was an amalgamation of the smaller roads, this minute direction of the one responsible officer passed beyond the limits of any one man's capacity. Certain measures of authority had to be delegated to others, but the operations were not often so extensive as to baffle the personal inspection of the responsible manager. As, however, the larger railways have been extended over thousands of miles and there has been an amalgamation of large roads into systems, each penetrating many states, traversing both lowlands and mountains, with traffic increasing in density and variety, there has arisen that complicated organization the results of whose coördinated performance are absolutely beyond unaided physical perception.¹

It is not therefore surprising that the railroad organization to the uninitiated seems to be bound round and round with an endless amount of "red tape," exhausting patience and trying and expensive; whereas if the organization were properly understood and the activities of each department borne in mind, this seeming over-complexity would disappear.

¹ *The Workings of the Railroad*, by Logan G. McPherson.

Railway administration involves so many and such widely varied subjects as to require for its successful conduct the largest possible survey as to commercial conditions, coupled with a knowledge of detail that takes into account all the varied operations incidental to the service. Properly to manage such an undertaking necessitates the employment of "many men of many minds," and the plan by which homogeneity and efficiency are attained is known as railway organization.

GENERAL SCHEME OF ORGANIZATION

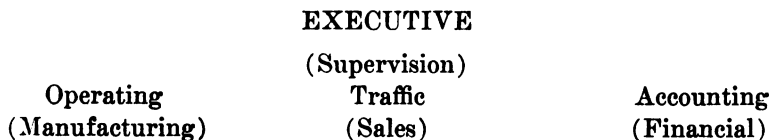
There are two elements in any undertaking: the plan to be followed—what it should be when completed—and the time at which the work should be undertaken. The first involves design and method; the second, executive policy. The first may be stated to rest on organization; the second, on management.

Each railway organization defines the duties assigned to every member of the staff and so correlates their assignments as to cover the entire field of operations and at the same time to avoid any conflict in their performance. To the extent that this is lacking, inefficiency and consequent needless expense will follow. The lines of demarcation should be and usually are sharply defined and their strict observance insisted upon; otherwise departmental bickerings, the *bete noir* of railway operation, will be engendered and consequent inefficiency promoted.

In the last analysis the business of transportation does not differ materially from any commercial or manufacturing enterprise. The three grand divisions are the operating department (including the engineering and construction departments), the traffic department, and the financial or accounting departments, these departments corresponding in the order named to the

4 RAILWAY ORGANIZATION AND MANAGEMENT

manufacturing, sales, and accounting departments of industrial or commercial organizations. General supervision is vested in a chief executive officer or board, and there are then four distinct groups of transportation company employees, as shown by the following diagram:



Anticipating in a general way much that is to follow in detail, we may briefly survey the respective fields of departmental activity and aim.

The Executive Department

The executive department provides and directs the expenditures of the money to build, extend, and reconstruct the railroad and to equip it with the necessary rolling stock. The executive department is in touch with the investing public through the treasury division of the financial department, which sells the securities; with the business public through the purchasing division, which buys all material necessary to the maintenance and operation of the property; with property owners, colonists, and emigrants through the real estate division, which leases and disposes of the company's realty holdings on the most equitable basis; and with federal, state, and municipal authorities through its legal, valuation, and tax sections. It makes all contracts, except those covering traffic agreements with railroads, orders all improvements, extensions, and reconstructions, and exercises a general supervision over all other departments.

The Operating Department

The engineering division of the operating department spends all the appropriation authorized by the executive department for building, equipping, and extending the road. The engineering division is concerned with the property itself and has little contact with the public. It designs and constructs the original railroad with all its structures; extends and revises it as to line, grade, and curves where required; and in some instances has charge of the maintenance of the permanent way and structures, although on most roads this function is delegated to the operating division.

The operating department proper designs the equipment employed on the road; conducts transportation by moving freight and passenger trains over the road as expeditiously and as frequently as is compatible with existing demand; and generally maintains the railroad with all its structures, equipment, rolling stock, tools, and appliances. In these days when service is practically the only inducement that competing organizations have to offer the shipping public, the operating department is called upon to meet such competitive service as may be established from time to time as to schedules, trains, or cars for both passengers and freight.

The Traffic Department

The traffic department, through the sale of transportation, is expected to supply the funds necessary to operate and maintain the railroad, and to pay interest charges on the money invested in the roadbed and equipment and the taxes which are levied against it, having something left over for a return to the stockholders or investors. This department has a more intimate relation with the public (so far as freight business is concerned) than

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RAILWAY ORGANIZATION AND MANAGEMENT

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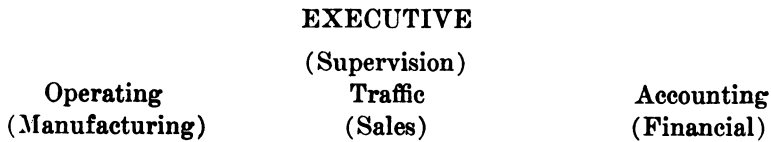
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any other department of the road. It solicits business directly like any other commercial concern; entertains all complaints for real or fancied faults in the transportation service; adjusts rates to meet the changing commercial conditions; and defends them against attack before regulating bodies or shippers. It is charged with the duty of getting the business; of guarding the company against the loss of revenue and business by keeping the rates so adjusted as to maintain itself against competitors; of developing to the fullest possible extent the resources and industries within its own territory; and of establishing profitable relations with its connections and competing lines.

The Financial Department

The financial department through the treasury division is the custodian of all the company's funds and its paymaster for all departments. It is responsible for all securities and for the proper form of all stocks, bonds, and notes. It is informed as to the maturing dates of all of the company's securities and usually advises the president and the board of directors as to plans for their renewal.

The financial department through the accounting division audits and keeps the record of all receipts and disbursements of money. It at once safeguards the resources of the company and analyzes the results of its operations. It makes reports of the business and financial status of the company to the various regulating authorities.

Subdivisions

The foregoing summary, however, constitutes only four very general divisions of activity, which may be further analyzed as follows:

- | | | |
|------------------|---|----------------|
| 1. Supervising | { | 1. Executive |
| | | 2. Legal |
| 2. Manufacturing | { | 3. Engineering |
| | | 4. Mechanical |
| | | 5. Operating |
| 3. Sales | { | 6. Traffic |
| | | 7. Purchasing |
| | | 8. Treasury |
| 4. Accounting | { | 9. Accounting |
| | | 10. Valuation |

Of those departments which have not as yet been explained in the preceding pages the activities may be summarized as follows:

The mechanical department has charge of all matters pertaining to mechanical engineering. It determines the standards for various classes of locomotives, cars, and other equipment.

It has general charge of the shops and other facilities for constructing and repairing the rolling stock.

The legal department draws up deeds, contracts, and agreements of all kinds, acts in an advisory capacity for all departments in legal matters, attends to any litigation in which the company may become involved, prepares mortgages covering the company's property, and the like.

The purchasing department is like the ship's cook, "in every man's mess but in no man's watch." On requisition from the other departments it purchases all supplies and material required for operation or for renewals and repairs, and sells worn-out material which has a scrap value.

The valuation department collects and tabulates all the necessary data to determine the actual value of the physical equipment of the company in connection with the investigations now being conducted by state and

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federal regulating bodies. The values are prepared usually to justify the companies' claims in regard to existing rates or proposed advances, as well as to show the relation between the actual value of the railroad property and its capitalization. These values are sometimes used in securing additional capital loans.

The work of each one of these departments is subdivided in much detail, for while the work within a department is directed towards a common purpose, its accomplishment requires service of a varying character. The diagrams used in this work will explain in detail the character of each one of the general subdivisions of these departments.

It is to be understood that on smaller roads two or more of the departments mentioned will be combined and managed by one general officer, but the nature of the duties will be much the same on a small road as on a large one. In fact the organization of the larger systems represents the combination of many similar original operating units.

CHAPTER II

SUPERVISION

THE BOARD OF DIRECTORS

Since a corporation is an artificial entity, it can act only through representatives. These are: (1) The majority of a quorum of corporate members duly assembled in a corporate meeting; (2) a majority of directors duly assembled in a directors' meeting; (3) officers of the corporation who are considered parts of the organization; (4) agents, who are not considered parts of the organization, but who represent it as any agent does his principal; and (5) servants, who do not represent it, but simply work for it.

Shareholders perform the extraordinary and unusual functions, such as electing directors, accepting and rejecting amendments, increasing and reducing the capital stock, making by-laws, admitting members, and in some circumstances removing officers or restraining ultra vires transactions, disposing of all the corporate property, and winding up the corporate business or surrendering the corporate franchise and so dissolving the corporation.

The directors control the ordinary business affairs, such as the policy of management; the decision on the expediency of acting or contracting; selecting the higher officers, fixing their compensation, and directing their actions. Within this scope of their authority, if they act in good faith, the stockholders cannot dictate to them, nor control their acts in any particular; the stockholders' business must wait until the time for a new

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election for selecting such directors as will conform to their wishes, unless the power of removal of officers has been reserved to the shareholders by statute, charter, or by-law provisions.

The board of directors for a local line represents the larger business interests of communities through which the road is constructed, who have subscribed to securities or pledged themselves for the amount necessary to construct the properties. As a rule, they choose as president one of their most influential men of affairs.

The ownership of larger systems, however, is a matter of some interest. The best figures obtainable as to the number of railroad stockholders show 440,000, and while the number of bondholders cannot be determined with the same accuracy, information concerning a few of the railroads develops that the number of bondholders exceeds the number of stockholders and that 1,000,000 is not an unfair figure to represent those who hold railway securities. Many of these holders are women and children, charitable institutions, savings banks, insurance companies, and trust companies. The average for each owner of railroad property is \$13,600. Of course, some individuals hold very much more than this and very many hold very much less, but the statement that railways are owned and controlled by a very few rich men is not correct. These 1,000,000 owners represent at least 4,000,000 people in the United States, whose daily bread and butter depends more or less on the success or failure of railways.¹

The owners of the property may vote, directly or by proxy, for one or more of their members or competent talent to act as directors to manage and direct affairs of the corporation, the whole of the directors collectively forming the board of directors.

¹ From an address by Howard Elliott, Montana State Fair, Helena, Mont., September 26, 1910.

In these days, when the insurance companies and other corporations hold enormous blocks of railway securities, they are frequently in a situation to elect their nominee.

The board of directors, in most cases, nominate one of their members to act as chairman of the board, and not infrequently the chairman of the board is also the president of the organization. In a number of cases, however, the office of the president is entirely separate from the board and the president reports to the chairman of the board.

The directors must also act in a duly called meeting. They have no authority to bind a corporation by their individual acts done outside the corporate meetings. In the absence of a provision to the contrary, the quorum of the directors' meeting is a majority of all the directors. They vote as individuals and not according to shares, and cannot vote by proxy.

GENERAL EXECUTIVE OFFICERS

The President and Vice Presidents

In the earlier history of railroading, the participation of the president in the management of the physical property was usually only nominal. In many instances his financial standing, national or social prominence, or ability as a diplomat in dealing with investors or the general public had more to do with his selection than his knowledge of practical railroading. He was chairman of the board of directors and keeper of the company's seal, but his direction over the practical affairs of the company was only very general.

This, as one might suppose, was very unsatisfactory. Executive orders would be issued and policies outlined which militated against the interests of the property, in that their ultimate effect could not be readily antici-

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pated or perceived by such executives, who were unacquainted with the inner workings and routine of railroading. For some years past, the presidents of practically all the railroads have been men who have risen in the railroad service from the ranks. Much the larger proportion come from the operating department because that employs the greatest number of men. There are many, however, who have achieved their position by promotion through the traffic or the financial department.

The president executes the plans of the directors by assigning to each department its proper place in the scheme of affairs, in harmony with the particular line of work which may be assigned to that division.

The president has general supervision and direction of all departments. He usually has an assistant who relieves him of the detail and routine work of the office as much as possible. There may also be one or more vice presidents, the number varying according to the size of the organization. They are generally at the head of separate departments, acting with the president in an advisory capacity.

Typical illustrations will be given to show the general office organization of various railroads and transportation systems.

The Nashville, Chattanooga & St. Louis Railway (1,230 miles), has one vice president assisting the president. He is in charge of the traffic of the road.

The title of the officer in charge of the accounting and treasury departments is comptroller; of the operating department, general manager.

On the Norfolk & Western Railway (2,043 miles), the president has an assistant and three vice presidents. The first vice president is in charge of the treasury and accounting departments. The second vice president is

also general manager and has charge of the operations of the transportation department, general supervision of all railroad property, and responsibility for its safe and economical management. The third vice president is the traffic manager and has general control of the traffic department.

The Louisville & Nashville Railway (4,937 miles) has a president and first vice president reporting to the board of directors. Three other ranking vice presidents report to the first vice president. The second vice president is in charge of the financial and accounting departments. The third vice president has two assistants and supervises all traffic. The fourth vice president has supervision of the transportation and of the engineering and mechanical departments. The secretary, purchasing agent, and general counsel in charge of the legal department also report to the first vice president.

The Pennsylvania Railroad (5,368 miles) has a president with two assistants, a special assistant, a general assistant, and four vice presidents. The vice president in charge of operation supervises transportation, the mechanical department, the maintenance-of-way division of the engineering department, and the pension department. Another vice president has charge of all matters relating to traffic. The vice president in charge of finance supervises the treasury department and the employees' saving fund. There is also a vice president in charge of real estate, purchases, and insurance. The comptroller in charge of accounting, the secretary, the chief engineer in charge of the engineering department, and the general counsel in charge of the legal department report directly to the president.

The organization in charge of the 18,000 miles of railroad formerly under one control and known as the Harriman Lines is particularly interesting by reason of

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the large amount of mileage involved. It has been altered somewhat by the segregation of some portions of the system and other causes. Originally the system comprised the Oregon-Washington Railroad & Navigation Company, The Union Pacific Railroad, the Oregon Short Line Railroad, and the Southern Pacific Company (Lines in Louisiana, Texas, New Mexico, Arizona, and Mexico).

Reporting to the chairman of the board of directors and the president was a director of maintenance and operation who had supervision over the approximately 18,000 miles of lines. Under this director, in addition to the vice presidents (and the president of the Southern Pacific Company lines in Mexico), were two assistant directors, director of purchases and supplies, mail traffic manager, electrical engineer, and consulting engineer—all staff officers; that is, system officers without direct charge of particular sections of the line.

Each of the constituent companies of the system (except the Southern Pacific Company lines in Mexico which were under the supervision of a president), was under the supervision of a vice president reporting also to the director of maintenance and operation.

The purpose of this form of organization is stated by the director of maintenance and operation to be "that the different properties be brought into close relationship with each other, yet preserve a full measure of autonomy. . . . The office of director standardizes and correlates, supervises and investigates, equalizes and differentiates as among different properties, but leaves each to work out its own problems of administration. The management of the properties is vested in seven operating vice presidents, each of whom is working out solutions of problems on his line which are common to all. A study of seven solutions of the same problem

must necessarily demonstrate that one of the solutions is the best.”²

The discussion of the other departments—legal, financial, traffic, etc.—of this system would not disclose any new principles and is therefore omitted.

The duties of the various vice presidents and other officials mentioned, where they are not obvious, are discussed later under the various departments to which they may be assigned.

The Secretary

The secretary gives notice of all meetings of the board of directors and keeps a record of its proceedings and in some instances of the meetings of its special or standing committees.

He attends to the publication of legally required notices of annual and special meetings of stockholders and of elections. He notifies the chief financial officer, whatever his title may be, of all action taken by the board in the sale or purchase of securities and all its transactions involving the receipt or disbursement of money by the railway company.

Transfers of stock and books showing its ownership—except stock registers—are under his charge. He signs all stock certificates and has custody of the originals of contracts and agreements made by the board.

Under the direction of the secretary, the transfer clerk has charge of stock transfers and the books showing its ownership. He prepares for the treasurer the dividend list and for the board of directors the list of the stockholders who are entitled to vote at the stockholders' meetings.

² From an address by Mr. Julius Kruttschnitt, director of Harriman Lines, before the New York Railroad Club.

FINANCIAL

Registrar of Stock

This officer is under the direction of the official at the head of the financial department and is responsible for the registration of the stock certificates. After transfers have been made he cancels the old certificate and signs, as registrar, the new certificates issued in their place.

Treasury Department

The treasurer is the custodian of the money and securities belonging to the railroad. The sources from which funds are received by him are: earnings from operation, that is freight, passenger, mail, and express revenue; rentals for use of company property; interest and dividends upon securities owned by the company; payment by subsidiary, allied, or other companies of loans made by this company; sale of bonds, stocks, or notes. The principal source of revenue is the remittances received from the company's agents, who send the money direct to the treasurer.

The payments made by him are for labor, as shown by the company's pay rolls; for material used by the company in maintenance and operation; for construction work; for certified claims against the company; for taxes, interest on bonds, notes, and indebtedness, and dividends on stock.

He makes arrangements for the banking facilities required by agents and others on the road, and in consequence must be advised of the condition of banks and places of deposit.

He keeps a set of books showing the receipt and disbursement of all money he handles and furnishes the comptroller daily a statement of all money transactions.

His books are balanced monthly by the comptroller. He also reports to the board of directors at each of its meetings his receipts and disbursements since the previous meeting.

He receipts vouchers and indorses checks drawn in his company's favor, and issues instructions to all money-receiving agents of the company as to the time and manner of making remittances.

He is charged with keeping sufficient funds on hand to meet all obligations, but must keep all funds not so employed at interest. In order to do this he is furnished periodically with estimates of the requirements for maintenance and construction and of probable receipts from traffic and transportation sources.

THE LEGAL DEPARTMENT

This department, while a distinct unit in railroad organization, is very closely allied with the executive department. The fact that legislation has hemmed railroad operation with a veritable hedge of "thou shalts" and "thou shalt nots" has necessitated the employment of the most competent legal talent to see that the many angles of finance operation and regulation are fully and adequately complied with.

The General Counsel

The general counsel bears much the same relation to the railroad corporation that the doctor does to the ordinary mortal; namely, he sees it into the world, acts as its adviser during its progress through life, and finally commits it to oblivion—e. g., in bankruptcy or consolidation. He sometimes goes even further and resurrects it in a reorganization.

Corporate Advice

A very large part of the time of the law department is devoted to giving verbal and written opinions on questions submitted to it by all departments, under the general impression perhaps that it is better to see your lawyer before taking an important step than afterward.

The very suggestion that the road is to be built calls for the services of legal talent. It is necessary to obtain a charter from the state in organizing a railroad corporation. Through a charter only can it obtain the right to charge for transporting passengers and goods and the right to condemn land in acquiring its right of way and other real estate. The state has the right to acquire land for public purposes and it delegates this right, with certain limitations, to a railroad company by means of its charter. The work of preparing the necessary legal forms and securing the charter is of necessity delegated to the legal department, as are the preparation of the by-laws governing the conduct of the business and management of the company, and the drafting and amending of the by-laws from time to time as the occasion demands.

When railroad corporations are consolidated with each other, or when railroads are purchased, the minutes of the meetings of the stockholders of both companies are often most elaborate and must be drawn with care to comply with the requirements of state laws. When other companies are leased, the terms and conditions of the lease as to payments, improvements, and additions to the leased property must be carefully stated to protect the interests of both companies.

Most of our roads have undergone reorganization on one or more occasions. This involves an immense amount of legal work in drawing agreements and adjust-

ing differences among the holders of different classes of the outstanding securities.

The important corporate action of the board of directors generally takes the form of written resolutions, and these with the minutes of the meetings of the board have a direct legal bearing on the securities issued by the company. Such resolutions and minutes are drawn therefore with the greatest care by the legal department, as the validity of securities representing very large sums of money is involved.

The security for the bond issues of the company is the mortgages, given by it on its physical property or other valuable possessions. The provisions of a mortgage must be such as to secure the bondholders to the greatest extent and yet not hamper the company any further than is absolutely necessary in carrying out a constructive financial program involving possible future borrowing. This requires legal skill of the highest order.

When a railroad company is unable to buy required equipment outright, either through the embarrassing provisions of former mortgages or for other reasons, contracts for its conditional purchase must be drawn. In other cases such needs may be better supplied through a lease. In either case, as large sums of money are usually involved, the drawing of the contract or lease requires technical legal knowledge.

The legal department is also called upon by all departments of the railroad to prepare contracts and agreements. Traffic arrangements between connecting roads are often reduced to written contracts. Traffic rights are granted to one railroad company over the lines of another, and the conditions attending such matters must be carefully stated to avoid misunderstanding, probable litigation, and the contingent expense.

So with the carrying of express and mail; the operation of sleeping cars or other special equipment; the use of union passenger stations; the construction of new lines, additional tracks, or other improvements; crossings (either grade or overhead); interlocking plants; the construction of industrial spur tracks; licenses to erect wires along or across the right of way or to lay pipes or make ditches on, along, or under the road-bed; the use of bridges, ferries, and terminals; and the purchase of coal and the like—these are but a few of the many problems that may be referred to the legal department for their advice. True, in many instances there is a form to fit a particular occasion, like the construction of a side track or the lease of property, that has been drawn and approved for future use, but the importance of many of the projects is such that it is highly desirable that the document, with the many “riders” that have been attached, be passed upon by the legal department before being executed by the respective officials.

The regulation of the railroads by the states and by the Interstate Commerce Commission is becoming more pressing and intimate. It is recognized that in principle this is necessary and just, but in recent years there has been proposed and passed much legislation that is contrary to the best interests of effective transportation and of the shipping public, proffered by legislators unacquainted with the practical side of transportation.

Litigation

The nature of the railroad business, to a greater extent than that of any other corporation, invites litigation. There are those who regard the railroad as fair game and do not hesitate or scruple to attempt to raid the company's strong box on the slightest provocation.

The railroad property is spread out over a vast territory and many of its employees are isolated and not under the direct supervision of its officers. It performs millions of individual acts in transporting persons and property, with a possible lawsuit in any one of them.

Claims for injuries to employees, when not adjusted otherwise, often entail long and expensive litigation, with a possibility of a large verdict for damages.

Claims for loss and damage to goods on some roads have cost as much as two and one-half per cent of the gross freight earnings. The loss to passengers' baggage, while generally small, often causes vexatious lawsuits. On all roads, in spite of fencing and track policing, the suits for injury to live stock still persist; fire from the sparks of locomotives may burn up a field, damage an orchard, or destroy a town; the construction of a railroad embankment across a creek bottom may be assigned as the cause of an overflow inundating a considerable area of high-priced bottom land; the wages of employees are occasionally garnisheed—these and many other things may be relied upon to keep the attorneys and their assistants busy.

In the prosecution of offenders against, or trespassers on, the property of the company, care must be taken to avoid suit for malicious prosecution. The condemnation of land for right-of-way purposes during periods of construction, extension, and improvement involves extensive and always costly litigation.

Not infrequently, even when such matters as those just mentioned are not brought into court, the legal department is called upon to adjust the claim, which may involve as much work as the lawsuit itself.

As typical of the organization of the legal department of the larger systems, that of the Atchison, Topeka & Santa Fe Railway (9,200 miles) has been selected and is indicated by Figure 1.

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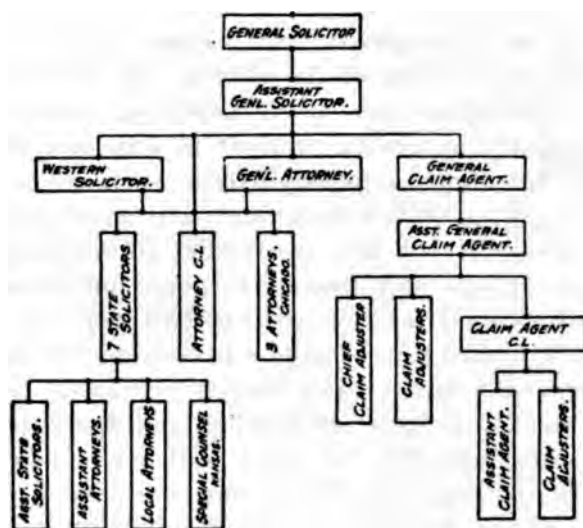


FIG. 1.—Organization of the Legal Department, Atchison, Topeka & Santa Fe System

In this organization the general solicitor is the chief of the division. His immediate subordinate is the assistant general solicitor. The title of general attorney comes next in line. These officials have reporting to them assistant solicitors and assistant attorneys. All of them have lawyers as assistants in their offices in addition to the office clerical forces.

The district or state solicitors report generally to these officers, and the local attorneys report through the district or state solicitors.

Where the claim department is under the direct supervision of the legal department as in this instance, there is usually a general claims attorney or agent with various assistants and claim adjusters reporting to this division of the department.

It is impracticable for the general counsel and his assistants in the general office to be familiar with the

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RAILWAY ORGANIZATION AND MANAGEMENT

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Directions

1. These questions should not be answered until the text matter has been studied and all the test questions in the back of the book have been answered.
2. Use a typewriter or pen and ink.
3. Write your answers immediately underneath the questions.
4. Make your answers brief but not to the point.

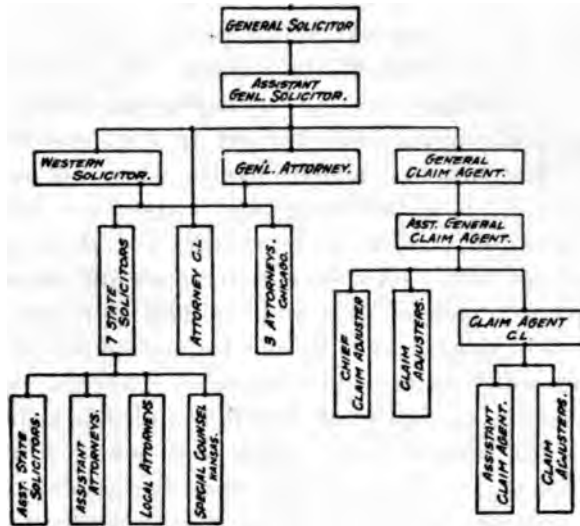


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Individual railway systems too have grown from short 100 miles into enormous consolidations embracing more than 20,000 miles of line with common interests and a common management. Such huge businesses require the best output of the human mind in order to secure the proper co-ordination of effort on the part of all the various employees. And after a brief glance at the questions involved, you will appreciate how intricate are the problems that confront the railway executive and how essential it is that all traffic men, whether railroad or industrial, shall have some comprehension of how they are solved.

One of the first problems arising in every railroad man's mind is that of financing all operations from the time the road is first projected, thru its periods of prosperity and depression, and even thru a receivership and consequent reorganization. You know that ultimately every railroad has the object not only of providing transportation facilities for passengers and property, but also of securing profit for the owners, who may be scattered all over the nation or even all over the world. (For instance, the Pennsylvania Railroad Company has just reported that its stock is held by more than 141,000 persons.) Many billions of dollars are invested in railroad securities and consequently in railway property; other billions are constantly being received as payment for the carriage of persons or goods and are in turn being paid out for wages, materials, interest, and dividends. Thus it is evident that the proper handling of these sums and the proper accounting therefor are both man-sized problems.

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local laws and conditions. Usually there is a company attorney in each of the counties traversed by its line, with a district or state solicitor to exercise supervision over all the local attorneys in his district or state.

It is to be understood that the organization of the legal department as to the number of its employees varies approximately according to the mileage of the system. An exceptionally small line, as a logging road, tap line, or the like, may have no permanent legal department in its staff organization, simply paying retainers to the most competent counsel it can secure to act for it as occasion demands.

CHAPTER III

ENGINEERING

The subjects generally discussed in this chapter are matters coming under the direction of the chief engineer, who is in all cases a civil engineer. This division embraces not only civil engineering work, but also that usually coming under direct supervision of an electrical engineer, who reports to the chief engineer. There is a sharp distinction, however, between the term engineering as here used and mechanical engineering, which relates to the design, construction, and maintenance of motive power and rolling stock, and which is discussed later.

The work of the engineering department may be divided into two distinct parts, construction and maintenance of way. On a road having one or more sections of its line electrified there are separate divisions for electrical construction and maintenance in the electrical zone.

• CONSTRUCTION

The chief engineer is responsible for the construction of the railroad. The location of its line involves a great deal of detailed field examination and office study and analysis on his part. Prior to the beginning of construction, standard plans for roadbed sections, track, bridges, culverts, buildings, and the numerous structures of a railroad are prepared, as well as plans for structures and situations requiring special treatment.

Plats showing accurately the dimensions and areas of all land required for right-of-way, station, or terminal purposes are made, so that all such land may be definitely described in deeds transferring it to the company.

Specifications for the construction of the railroad are prepared describing in detail the character of the various classes of work to be done and prescribing the manner of doing it. Proposals to do the work are invited from contractors and when received are tabulated and compared and the contract is awarded on the basis of the proposal which is the most advantageous. The contractor then assembles his forces and plant and actual construction begins.

The right of way and real estate are acquired as far in advance of actual construction as conditions will allow. It is rarely all obtained before construction begins, and its acquirement is often a source of serious delay to the construction forces. The work is generally performed by men trained through former service in that particular field. In cases of lines constructed in a country without transportation facilities, securing the necessary land is a comparatively easy matter; in a district already provided with railroad facilities, it is often a tedious, expensive, and vexatious feature of the construction, involving much negotiation and at times condemnation proceedings. The right-of-way men generally report to the chief engineer, but often to the general counsel.

The work is divided for construction purposes into sections varying in length as to the character of the construction. On light work—that is, where the country is comparatively flat with no important bridges or other structures and construction—a section may be from ten to fifteen miles long as a maximum; on heavy work, involving the moving of large quantities of material,

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the sections are reduced to six or eight miles, and with much bridge or special work they are still shorter.

These sections are called "residencies" and are in direct charge of a resident engineer, who with his party directs the construction in accordance with the plans, specifications, and instructions of the chief engineer. The party consists generally of three men in addition to the resident engineer and such inspectors of masonry, pile, and timber structures as the nature of the work may require.

The resident engineer sets stakes marking the outside lines of all cuts and fills and in doing so cross-sections the surface of the ground to determine the quantities of material to be moved; he defines the lines of all masonry, timber, and other structures and sets stakes to mark the limits of the company's right of way and real estate.

During the construction of the work the character of material excavated is carefully noted for the purposes of classifying it, as the unit price paid for the material depends on whether it is earth, loose rock, or solid rock. Foundations for all structures are carefully examined before building; all material, such as sand, stone, cement, piles, timber, pipe, etc., is inspected before being used.

As the contractors are paid monthly, the resident engineer makes an estimate of the amount of work done at the end of each month, which is sent to the office of the chief engineer as the basis of the payment.

On almost any line of railroad there are one or more important bridges which are under the direct supervision of the bridge engineer, who usually reports directly to the chief engineer.

In a rough or mountainous district involving the construction of long tunnels, such work is generally in

charge of a resident engineer familiar with underground construction.

The office engineer supervises the drafting of all maps and plans, checks the monthly and final estimates, and indexes and files all estimates, reports, and notes as they are completed in the field.

As the roadbed is finished ready for the track, the superintendent of track begins the actual laying of the rails, which is usually done with the railroad company's own forces. Prior to the track laying, the rails, ties, joints, spikes, switches, etc., have been received and stored in a material yard, convenient to the point of beginning of the track laying. Where steel bridges are to be erected, the masonry is constructed at the same time as the rest of the work, but the steel superstructure is not erected until the track has been laid to the bridge site. The material for bridge superstructure is stored in the same yard as the track material and is moved to the bridge site by the construction trains of the track force.

All this track, bridge, and other building material is received at the material yard and checked out to the track forces by the material clerks, who account for all of it to the superintendent of track, who in turn reports to the chief engineer.

As track laying progresses, the construction of stations, telegraph lines, water tanks, and other necessary buildings and structures and retaining fences begins, following the track construction as closely as possible, the material for such structures being hauled by construction trains from the material yard to the sites of the structures. As the track is surfaced—that is, brought to true line and proper grade for actual operation—the road crossings, cattle guards, and such structures are placed, so that by the time track laying and

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surfacing are completed the line is ready for actual operation and is turned over to the operating department.

RECONSTRUCTION

The reconstruction of a railroad is often undertaken primarily for the purpose of reducing the controlling grades and improving the alignment (eliminating curves), but there are some other very important matters given consideration at the time of such reconstruction.

The original roads of the country were from economical necessity constructed as cheaply as possible. Where the business of a road continually increases there comes a time when more money can be saved in operating expense by making certain improvements than the interest on the cost of such improvements. Under such circumstances if the money market is normal and the credit of the company good, such improvements are undertaken, and the chief engineer through his construction organization determines the most feasible and economical plan for reconstructing those portions of the line where the conditions surrounding the operations demand it.

On all railroads there are grades called maximum or controlling grades, which limit the tonnage that any given locomotive can haul over a division. These grades usually occur where the railroad crosses ridges or mountains in passing from one system of drainage into another. By reducing the grade—that is, the rate of rise (as from 1 foot in 100 feet to 0.5 feet in 100 feet), the tonnage of the train may be increased. Such grade reduction generally increases the depth of the excavations near and at the summit of the grade, and the height of the embankments in the valley, as well as the length of the “fill.”

This usually necessitates the abandonment of some portions of the old roadbed, particularly if the reduction in grade is radical, and the location of an entirely new line. If the abandonment of the old line is not necessary, the grade change often requires that temporary tracks be built along those portions under reconstruction, to carry the traffic during the time the old roadbed is being altered (raised or lowered) to the newly established grade line.

The determination of the best plan and method to be employed in such reconstruction requires a great deal of detailed field examination and office study of the data so obtained. There are many possible ways in which any given line may be reconstructed to certain standards of grade and alignment but there is always *one* best way—that is, some plan which accomplishes the things sought with the expenditure of the least money, and the engineer is charged with finding and being able to demonstrate that some particular plan is this one best way.

In order to do this, all reasonably possible schemes will be tested and a statement of cost and resulting operating conditions for each of them will be made for the purpose of comparison. This involves the making of surveys developing all the topographical features of the country and the drawing of maps and profiles from the data gathered, which must show accurately all the conditions affecting the construction and operation of all the proposed lines, from which an estimate of cost is made. Such examination and study will show decisively the line best suited to the conditions from an economical standpoint.

What has just been said relates only to certain portions of the railroad, as much of the old roadbed may be used on those portions where the original grades or curves are not in excess of the proposed new grades

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(rates of grade) and curves. What follows applies to all of the railroad that is to be reconstructed.

At the time of reconstruction it is usual to widen the excavations and embankments so that none of the ballast will be lost and to secure better drainage in the cuts. Often the width at the bottom of earth cuts in the original roadbed did not exceed sixteen feet and this is widened to about twenty-six feet and the slopes are flattened; the embankments originally built fourteen to sixteen feet in width are widened to twenty or twenty-two feet.

Most of the bridges and many of the culverts in the original construction are of a temporary character, being made of timber; these are rebuilt entirely, with the substitution of permanent steel and masonry or reinforced concrete structures for the original temporary bridges and cast-iron or reinforced concrete pipe for the timber culverts and tile pipes of the original line. The original steel bridges also are replaced by new ones of much heavier construction capable of carrying larger and heavier locomotives and cars.

The lighter rail and track structure is replaced with a heavier rail and the ties protected from mechanical wear by tie plates, the ties themselves in many instances being treated chemically to prolong their life by resisting decay. Stone or gravel ballast replaces the earth or cinder ballast of the original line. Sidings at stations are lengthened and perhaps increased in number to provide for increased and prospective business. Passing tracks are built at shorter intervals along the road, and they too must be lengthened on account of lengthened trains, which the reconstruction makes possible.

Yards at terminal and junction points are extended and reconstructed to care for the increased business and

designed to facilitate switching operations, thereby reducing cost.

The passenger and freight stations originally of temporary frame construction are in many cases replaced with permanent buildings, having heating systems, gas or electric light, and modern plumbing installed. The larger locomotives require that engine-houses, machine shops, turntables, and often water and fuel stations be extended, enlarged, or wholly reconstructed.

With the increase in traffic the danger at highway grade crossings has increased much faster than the traffic. Many such crossings must be provided with overhead bridges or masonry underpasses constructed to afford reasonable safety for highway travelers. For the same reason and for the added purpose of avoiding the delay to trains, many grade crossings with their railroads must be abolished, and this usually entails the reconstruction of all roads using the crossings for some distance on either side.

The safety of operation with dense traffic often requires the construction of a signal system to avoid undue delays to trains and to insure their safety.

TRACK ELEVATION

In many of the larger cities and some of the smaller ones, the delays and danger resulting from the density of traffic on the railroads and of team traffic in the streets require the elevation of all railroad tracks within congested districts. Such elevation requires the building of comparatively high embankments, the construction of heavy masonry walls of stone or concrete to retain them within the railroad right of way, and the erecting of steel bridges with masonry abutments over the streets and alleys crossed.

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The grade of the street is usually lowered in order to provide "head room" for team traffic beneath the bridge without making the height of embankments excessive. This altering of the grade of the structure often necessitates the rearrangement of sewers, gas and water pipe, conduits for electrical and other wires, and all other subsurface structures because of the excavation of the street beneath the railroad structures and the street approaches thereto. This regrading necessitates the removal of the street pavements and walks and their replacement after all the subsurface work has been performed.

ADDITIONAL MAIN TRACKS

As traffic increases still further, additional tracks are required, which involves much new construction. (In some instances the road is double-tracked when it is reconstructed.)

The excavations and embankments must be widened to provide room for the additional track. The widened embankments require the lengthening of all culverts, pipes, and drains. The widened excavations demand the lengthening of all overhead bridges and the reconstruction of the road approaches thereto. The abutments and piers must be extended and additional bridge spans erected on them.

Passing tracks and sidings are rearranged and the additional track itself must be constructed. Many buildings on the right of way, particularly station buildings, are moved or often reconstructed. Road crossings and many other minor structures have to be adjusted to the new construction.

Double-tracking a line under traffic, particularly if the cuttings are deep or are in rock and the embankments high, requires careful planning and skillful man-

agement of the construction forces to avoid serious interruption of the operation of trains. Often embankments are raised or cuts deepened at this time, which necessitates the shifting of the traffic to temporary tracks several times during the construction.

TERMINALS AND YARDS

- The growing traffic of a road demands the rearrangement—often the reconstruction—of terminals and yards at important connections. The construction of the Pennsylvania Terminal in New York cost over one hundred million dollars; the reconstruction of the New York Central Passenger Terminal at the same place, eighty million dollars; the construction of the new Chicago and Northwestern Railway Passenger Terminal at Chicago, thirty million dollars; the reconstruction of the Joint Terminal by the Pennsylvania, the Chicago, Burlington & Quincy, and the Chicago, Milwaukee and St. Paul Railroads in Chicago is estimated to cost sixty-five million dollars; and the building of the New Terminal at Kansas City, fifty million dollars.

All such work involves not only the construction of the facilities of the railroads themselves but the adjustment of surrounding conditions to them. The Chicago terminal work, just referred to, involves the building of a bridge across the Chicago River, the reconstruction of streets adjoining and crossing the terminal properties, and much other work of a complicated and special nature.

Often large storage, interchange, classification, or clearing yards must be built, enlarged, or rearranged to accommodate increased or changed conditions of freight traffic at some terminal or important connecting point. A notable instance of this is the construction of the very large yards at Clearing in Chicago, built to reduce the number of cars heretofore hauled into the city terminals

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and to facilitate the interchange of cars between the railroad companies operating it.

INDUSTRIAL AND SPUR TRACKS

The location of new industries along the road necessitates the construction of tracks connecting the plants of such industries with the tracks of the railroad. Such construction may be anything from a single short track to a complicated system of trackage or a spur of considerable length with many sidings.

These tracks must be adjusted to the tipples or other dumping or elevating facilities of the industries and to the various requirements of the plants served.

CHAPTER IV

ENGINEERING—Continued

DESIGN OF WORK

All the matters mentioned in the preceding chapter under Construction, Reconstruction, Track Elevation, Additional Main Tracks, Terminals and Yards, and Industrial and Spur Tracks, involve the making of detailed surveys and many maps, profiles, and estimates, and much general and specialized study of the data when so prepared before the best design for the work may be shown on the plans and the best method of performing it incorporated in the specifications for the work.

Engineer of Construction

The organization by which this is effected is under the supervision of the engineer of construction, who reports to the chief engineer. His title may be the one just given or assistant chief engineer, constructing engineer, or chief engineer of construction. His duties are the general supervision of all such construction work as has been mentioned, and he is responsible for the whole organization having charge of such work.

Locating Engineer

The locating engineer has charge of surveys for new lines and reconstruction projects. The work involves the gathering of the data in regard to the topography of the country traversed and other facts having a bearing on the construction or operation of the line.

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He is the engineer charged with the "trying out" of various possible routes for the location of the line, mapping them, estimating their cost, and comparing such cost and the operating conditions on each possible route with those of all other possible routes. He tabulates the results of all his investigations and embodies them in a report to the chief engineer.

The making of the surveys mentioned involves the employment of one or more locating parties composed of from twenty to thirty men, depending on the character of the district under investigation. Each party is under the direct supervision or in charge of an engineer generally called engineer in charge of party, who directs the movements of the party in securing the information required by the locating engineer.

The transitman has charge of a group of chainmen, stakemen, axmen, and flagmen, who mark the line on the ground with stakes driven at stated intervals (usually every hundred feet). He records in his notebook all his field observations, particularly the angles turned in running the line.

The levelman and his rodman take the elevation of the ground along the line and make a profile of it. The topographer measures the distances from the line to all natural objects and takes the slope of the ground on both sides of the line. The draftsman, from the field notes of the transitman, levelman, and topographer, makes a map showing the position of all objects, buildings, fences, streams, roads, and the contours of the ground, showing differences of elevation.

On this map the locating engineer projects various locations which are marked on the ground by stakes, and the costs of the various lines are then estimated for the purpose of comparison. The line finally adopted is indicated by stakes driven at intervals of one hundred feet on straight line and fifty feet on curves, which

line with the maps and profiles is the basis for all future work of obtaining right of way and actually constructing the line.

The decision as to the line to be adopted rests of course with the chief engineer, subject to the approval of the president and board of directors. A matter so important as the location of the line receives much of the personal attention of the responsible head of the engineering department. On some of the larger roads, the locating engineer devotes his entire time to that one subject, but often after locating the line he is placed in direct charge of the construction.

CONSTRUCTION ORGANIZATION

The line to be constructed is divided into sections called "residencies" as explained in the chapter on Construction of New Lines, whether the line is being newly built or reconstructed, as the work to be performed is similar in either case so far as the engineering organization is concerned. Several resident engineers report to a division engineer, who in turn reports to the construction engineer.

There are certain classes of construction found on all railroads which require special treatment in their design and method of construction. These different classes of work are placed under the immediate supervision of specialists, expert in their particular fields.

Bridge Engineer

The bridge engineer is responsible for the design and has supervision of the fabrication and erection of bridges. There are two distinct classes of work in bridge construction, the piers and abutments usually constructed of masonry and the steel superstructure which is erected upon it.

The building of the masonry often involves the construction of difficult foundation work, and for that reason certain engineers and contractors specialize in that class of work alone. The foundations of the Eads Bridge over the Mississippi River at St. Louis, the New York and Brooklyn Bridges over the East River, and the St. Lawrence bridge in Canada are examples of difficult foundations, either on account of the size of the masonry structures or because of the character of the material excavated to reach suitable foundation on underlying rock strata.

The sinking of caissons for bridge foundations in the beds of large rivers involves the use of a very extensive equipment consisting of a steam power plant, pumps, compressors, pile drivers, derricks, and many other appliances of a like nature, installed on barges and scows, together with tugs or boats to shift the plant and transport the construction material to the site of the work. The largest bridges in the country have been constructed under the supervision of consulting engineers and contractors confining themselves to such work alone. There are many bridges, however, on all the large systems of railroad which involve foundation work of the character described, which are constructed by the bridge engineer of the railroad organization.

On account of the very serious results that inevitably follow bridge failures, in loss of life and property, it is most essential that all material entering into their construction should be rigidly inspected and carefully tested. Such work is attended to by one or more engineers—usually called engineers of tests—as to certain qualities and by the careful analysis of their constituent elements by an analytical chemist. All this inspection, whether carried on at the steel mill or at the bridge site, is under the supervision of the responsible bridge engineer.

The work of this division of the engineering depart-

ment is outlined in a very general way only to show the nature of the duties of those engaged therein. It is apparent from the description that a large force of designers, draftsmen, computers, checkers, and clerks must be employed in the office and that superintendents, foremen, and many inspectors of power plants, masonry, concrete, pile, false work, bridge erection, and painting must be employed in the actual construction of the work.

The work of this division is perhaps more technical in its nature than that of any other railroad department and practically all its employees are technically educated or specially trained men.

Designing Engineers

There are many different classes of structures which are appurtenant to railroad property and essential to its operation. Many of its structures require special treatment in design and construction; others are repeated many times on different parts of the road. The first require special plans and specifications; the second are constructed according to standard plans adapted to local conditions. The engineers charged with responsibility in regard to the character and the adaptability of the structures to be built to the service required are called designing engineers.

There are usually some special fields covered by particular men, but the general duties are the same in all cases—that is, they embody the ideas of the chief engineer as to construction standards in the plans and specifications, or (when directed) suggest and submit several plans for a given structure or class of structures for his consideration. The classes of structures cover a wide range.

The section of the roadbed varies with the character of the traffic and the material in which excavations are

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made or from which embankments are built. Drawings showing the sections for these varying conditions are made, giving the width of the roadbed and the rate of slope of the material for lines with various conditions as to traffic, as main line or branch line, and for various materials, earth, solid rock, etc.

The track section also varies with the character of the trains and train service. For lines having heavy equipment the rails are of larger section, the ties usually being spaced at shorter intervals than for a line with light traffic. If the ballast used is crushed stone, its depth, width, and slope are different from those adopted for gravel, chert, or cinder ballast. If the ties available for use are of soft wood, the plan requires the use of tie plates; if good hard oak ties may be had at reasonable cost, the tie plates may be omitted. The plans show a track section for each of the varying conditions met on the road.

The angles of the turnouts for which switches are required vary, and in consequence the lengths of the switches vary. The switch standards show a list of all fixtures and the number and dimensions of switch ties for each different switch angle. They also show the dimensions of the switch stand and state in what circumstances a high, low, or ground throw stand shall be employed for throwing the switch rails.

A special plan for the sidings and passing tracks at each station and the large yards at terminal and important connecting points must show in detail each track and switch and every feature relating to its construction and operation. The yard may be a clearing yard at an important industrial center or terminal, a "hump yard" for sorting cars by gravity, a classification yard for breaking up or assembling trains, a storage yard for holding surplus cars, or a combination of all or a part of them.

In a rugged country involving tunnel construction the section and character of the tunnel varies with the character of the material encountered in its excavation. It may be in rock of so durable a nature that no lining is required; in some instances where lining is required, it is lined with timber; in others with plain concrete, stone, or brick masonry; in still others with concrete heavily reinforced with steel rods or shapes. The plan shows all the dimensions of the completed tunnel section and the method of drainage and ventilation if any are required.

Standard plans showing the construction of overhead or underpass bridge crossings for public or private roadways must be prepared. In some cases these are of steel girders on masonry piers, in others of reinforced concrete or structures of piles and timber only.

The station buildings are of several classes to suit the varying needs of the road. They may be immense structures of steel and masonry in important cities or very plain frame structures serving small country villages. There are several types and sizes of stations, say four or five, which may be adapted to nearly all the stations, and these four or five types are the standard plans for stations, each station being classified in reference to these types—first class, fifth class, etc. Special plans are made for the larger stations and for special situations, these very often being designed by an outside architect or by one in the service of the company devoting his entire time to such duties. There are special plans usually for each station constructed, showing the arrangement of water, gas, and sewer pipes and electrical wiring, if any.

The construction of docks and wharves demands special designing to meet the conditions prevailing at the site and of the operation itself. Fuel and water

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stations are constructed from standard plans adapted to varying local or operating conditions.

Engine-houses are designed in connection with the officers of the mechanical department, the latter attending to the installation of the plant, consisting of boilers, engines, various tools, and the system of piping air, steam, and water to the various engine pits. Machine shops, often of very considerable extent, require special plans. The space for each tool and machine is shown on the plans, and the foundations for such plans are made in coöperation with the mechanical department, as well as standard plans for turntables, cinder pits, and other minor structures appurtenant to engine operations.

The minor structures must all be built to certain standards and plans showing all dimensions and forms in great detail—the number, spacing, and kind of wires and the spacing of posts in right-of-way fences, the number and length of the planks in grade road crossings, the detailed construction of cattle guards, the dimensions and shape of all signs and the distance at which they must be located from the rails, the spacing of posts and planks in snow and sand fences, and the detailed construction of snow sheds, cattle pens, track scales, and all other structures.

It is attention to these details which in many instances seem trivial, and in others quite the reverse, that engages the designing engineer. All railroads are composed of units which were originally constructed under widely varying standards, and in consequence there are many structures on them which do not comply with the present standards of the company. The adoption of standard plans for all structures, with the exceptions noted, gradually standardizes the railroad through reconstruction and replacement of the original ones.

Track Elevation Engineer

The elevation of tracks over which many trains are operated in carrying a large traffic involves construction methods of a special kind, and such work is placed under the direct supervision of a track elevation engineer. The general description of the work heretofore given will make clear the duties of this engineer.

It is not possible, of course, to abandon the operation on any considerable number of tracks at the same time. The problem then of this engineer is to adjust his construction method to operation so as to cause as little delay to and interference with it as possible and to accomplish this with the least possible expenditure of money. It is not difficult to err in either direction, for too much concession to operation will increase the construction cost materially; too little will increase operating expenses and injure the reputation of the road as to service given shippers and passengers. In addition provision must be made for the street traffic at frequent intervals along the line.

The necessity in track elevation for bridges over the street at short intervals complicates the problem very much, for otherwise all tracks might be raised a little at a time with no serious delays either to the train service or to the construction forces.

In order to utilize as much of the right of way for tracks as possible, retaining walls of stone or concrete masonry are first built on both sides of the track, along the line between railroad and adjoining property. The material for raising the tracks to the required height must of course be hauled in from points where good material for the purpose is available. Sand is the best material, as it can be excavated and loaded economically by steam shovel, and when dumped from the cars in raising the tracks runs readily and is easily gotten under

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the ties so that the track being raised can be quickly brought to approximate surface after the material is dumped.

The traffic is shifted from track to track as the elevation progresses, the tracks being elevated in "lifts" of a few feet at a time. As the abutments for the bridges across intersecting streets cannot be built in advance of placing the material for track elevation, timber bridges, usually of piles, are erected across the streets and support the tracks after they have reached their final elevation until the permanent masonry and steel bridges have been installed.

The work involves large forces in the construction of the masonry retaining walls; one or more steam shovels excavating and loading the cars with the filling material; construction trains operating between the borrow pit and the tracks being elevated; large forces of men dumping cars and raising and shifting tracks; the driving of piles of the temporary bridge crossings in the intersecting streets; the removal of material in lowering the grades of such streets; the reconstruction of all pipes, conduits, and other sub-surface structures; surfacing, lining, and ballasting the elevated track; and the placing of the permanent pavement.

The plans for and methods of the construction are, of course, determined upon in advance of the actual construction, and the work demands the closest coöperation between the construction and operating departments. Many inspectors of masonry and timber structures and assistant engineers are required in "laying out" the work and seeing that it is properly constructed.

Engineer of Grade Crossings

The agitation for the abolishment of grade crossings of the railroads at public highways has forced the rail-

roads to undertake much construction work of this kind. The work of track elevation just described is, of course, for the purpose of abolishing the grade crossings in city streets. There is a class of work, however, in which the grade of the railroad is not altered at all or only slightly, the principal reconstruction applying to the street or road crossing the track. Such work is not so comprehensive as that described under track elevation, where all grade crossings in the entire district are eliminated by the one operation. If there are many crossings, at short intervals, the track elevation is the more economical method for the abolition of the grade crossings; if they are a considerable distance apart it costs less to alter the grade of the street or road than to raise or lower the grade of the railroad for the entire distance.

There is much of such work in the older, more densely populated districts, and on roads operating a great many trains, and there are certain points also on all roads, where from a combination of unfavorable conditions a grade crossing, even where train service is infrequent, is dangerous.

There are many other things than the mere regrading of the streets and roads that are incidental to such work. The rearrangement of ditches, drains, pipes, and other sub-surface structures often complicates the work seriously and requires the coöperation of the railroad and the municipal authorities to adjust the altered grades to meet the necessities both of the railroad and of the public.

The engineer in charge of such construction on the New York Central Lines is called engineer of grade crossings, and engineers with the same duties are employed on some other eastern roads. They are not so common on the western roads at present as they are likely to be later, although in the aggregate much work of this character has been done.

District Engineers

These correspond to the division engineers shown in the engineering organization for the construction of new lines. The district engineers have charge of the construction of large yards, or oftener of extension and reconstruction of the older ones, and of industrial and special tracks, and other miscellaneous work.

It is to be remembered in connection with railroad organization that the railroads are never finished but are in constant course of extension, reconstruction, and adjustment to changing conditions. On this account there is always more or less work for the construction division of the engineering department.

The district engineer has charge of all such work in a certain district. On the New York Central Lines East of Buffalo, with a mileage of 5,110 miles there are two district engineers.

His district, however, may well be confined to the construction of one large terminal, in which case he might be called a terminal or resident engineer.

Engineer of Maintenance of Way

The title of the engineer in charge of maintenance work may be engineer of maintenance or chief engineer of maintenance of way.

The engineer's duties relate, as the title shows, to the maintenance of structures and roadbed already constructed. He is responsible for the roadbed, ballast, ties and tie plates, rails and rail fastenings, switches, frogs and switchstands, fences and cattleguards, street and road crossings, track signs, tools and supplies, tracklaying and ballasting, bridges and structures, water and fuel stations, cinder pits, turntables, scales, and buildings of all kinds.

It is to be understood, however, that there is much replacement work—that is, building new structures to replace old ones worn out or unsuitable for use through obsolescence, inadequacy, or other cause. The replacement of bridges which are too light to carry safely the increased loads due to the heavier engines and larger cars is an illustration of replacement; the enlargement of existing engine-houses to accommodate larger (longer) locomotives is an example of another kind of maintenance work; viz., the adapting of existing structures to changing requirements.

In the section on Designing Engineers under the head of Construction, the duties of such engineers were explained. It is to be understood that such designing engineers are employed in the work of maintenance of way and structures as well as in construction work, and in fact to a greater extent on roads which have been in operation some years.

On a large system there are generally two assistants to the engineer of maintenance of way—the assistant engineer in charge of roadway and track, and the assistant engineer in charge of bridges and structures. The division engineers in the operating department report on engineering matters to the former; the foremen of bridges and buildings report directly to the latter or through the division engineers. The titles are descriptive of their duties in connection with the explanations heretofore given.

The signal engineer has charge of the signal systems, including the interlocking plants. He designs all the work in his department and supervises the maintenance through inspectors and signalmen. The bonding of the rail in the signal sections and its insulation require constant attention, and the maintaining of the various levers, rods, idlers, and other moving parts of the interlocking

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plants free from obstruction compels much work, particularly during the winter.

The engineer of water supply is concerned with the construction of the water stations, tanks, water columns, and pumping stations with the connecting systems of pipes.

The pump required may be a small steam or gasoline pump housed in a frame shanty on the right of way at some stream, or a plant of considerable magnitude situated some miles from the railroad; the pipe system, a short run of three-inch pipe or several miles of twelve-inch pipe carrying water at a considerable pressure. In some instances the work necessary in obtaining the water involves the construction of reservoirs with the dams, spillways, and much other work incident to such construction; in others, the drilling of deep wells with pumps adapted to such conditions.

Where the water is not entirely satisfactory for engine or shop use it must be treated chemically. The plant in which this is performed may be a very small one or of considerable extent requiring the design of a complicated system of settling and other tanks. The adoption of a plant suitable to any given situation requires the technical knowledge of the hydraulic engineer and the engineer in charge of water supply might well have that title.

Treating Plants

The supply of suitable timber for ties is one of the most serious problems confronting the railroads. The cost of ties is increasing rapidly and the available supply is fast disappearing. The best grade of white oak timber once so plentiful is so valuable for other purposes that white oak ties are becoming rare in railroad tracks. The principal sources of tie supply are the less durable

and softer woods. Unprotected from decay, however, such ties rarely last more than four or five years. In consequence, the ties are treated with various compounds for the purpose of increasing their resistance to decay, and tie plates are being more generally used to reduce the mechanical wear of the softer ties under heavy traffic. This treatment of ties and other railroad timber involves the construction of plants of considerable magnitude.

The plants for treating ties and timber and the work incident to such treatment are under the supervision of an official called the superintendent of timber-treating plants or some similarly descriptive title.

CHAPTER V

ENGINEERING—Concluded

ELECTRICAL ENGINEERING

What has been said heretofore for the most part applies to the construction of railroads operated by steam as a motive power. On many of the railroads there are zones of greater or less length within which electric traction replaces the ordinary steam locomotive operation. Up to the present time such electric traction has been confined to congested terminals, short tunnel sections, and peculiar operating conditions. The large investment required in electrification forbids its general adoption, in the present state of the art, except in such special situations or under peculiarly favorable conditions.

One of the first of the modern electrified zone operations on steam railroads was that of the Grand Trunk Railway in the tunnel connecting northern Michigan with the Province of Ontario. This submarine tunnel under the St. Clair River between Port Huron, Mich., and Sarnia, Canada, was completed in 1900. It is a single-track, iron-lined tube 19 feet in diameter and 6032 feet long, with approach grades of two per cent, the total distance between the ends of these grades being two and one-quarter miles.

The locomotive first used burned anthracite coal to avoid danger and inconvenience due to smoke and gas in the tunnel. The train loads were about 760 tons at

very low speed. Increase in traffic overtaxed the capacity of the tunnel, and its ventilating apparatus proved inefficient with frequent train service. Several accidents occurred, the train crews being overcome by the gas-laden atmosphere of the tunnel. To increase the traffic capacity and eliminate the danger incident to steam locomotive operation, electric traction was adopted and placed in operation in 1908. Such operation in tunnel sections is usually introduced for similar reasons. The Cascade tunnel in Washington on the Great Northern Railway, the tunnel of the Michigan Central Railroad under the Detroit River, and the Baltimore & Ohio Railroad tunnel at its terminal in Baltimore are examples of this class of electrification.

The electrification of the Pennsylvania Railroad, the New York, New Haven & Hartford Railroad, and the New York Central at their New York terminals, are instances of electrification demanded primarily by tunnel operation, which has been extended to some distance beyond the tunnel section to care for very heavy through and suburban passenger traffic. The very serious accident in the tunnel under Park Avenue in New York City, on the New York Central, was the basis of the demand made by the public for electrification. The long tunnels under the Hudson and East Rivers on the Pennsylvania Railroad demand electric traction for safe operation.

The electrification of the Long Island Railroad and a portion of the West Jersey & Seashore Railroad, both of which are controlled by the Pennsylvania Railroad, are examples of the electrification of steam railroads which are justified to a large extent by a large suburban passenger business, although in the case of the Long Island Railroad there has been much objection from the city of Brooklyn to the smoke nuisance caused by its steam locomotives. The loading of the power plant in

the original installation of the Long Island Railroad provided for a very heavy train movement.

Chicago, Milwaukee & Puget Sound

The Chicago, Milwaukee & Puget Sound has electrified a mountain section of its line in the Northwest, where hydro-electric power is developed under favorable conditions. The results obtained from this installation will be particularly interesting as developing the relative cost of steam and electric operation under the most favorable conditions to the latter, viz., cheap water power in a district where fuel cost is high.

The entire work cost approximately twelve million dollars and required three years' time to complete. The electrical energy is obtained from the mountain waterfalls along the route.

From Harlowton to Avery, 440 miles, the electrification crosses the Belt Mountains, where at the summit an altitude of 5,788 feet is reached; the main Rockies or the Continental Divide, an altitude of 6,322 feet at Donald; and the Bitter Root Mountains, an altitude of 4,163 feet at East Portal. Pipestone Tunnel, the half-mile bore through the backbone of the continent at Donald, is the highest elevation of the railway.

To give an idea of the difficulties to be overcome in this enormous undertaking, a two per cent grade had to be surmounted for a distance of 20.9 miles along the east approach to the Continental Divide; immediately west of the Continental Divide, for a distance of 10.4 miles, is a 1.66 per cent grade; and on the western slope of the Big Belt Mountains, for a distance of forty miles, a one per cent grade. This is the first undertaking to install and operate electric locomotives on tracks extending over several engine divisions and under the most difficult traffic conditions. The various terminal and

tunnel electric installations made by railways in the past were necessary by reason of local conditions and were limited to short distances. Purely economic reasons, together with anticipated superior operating results, caused the extended electrification of this line.

The electrical power employed to operate the entire 440 miles of electrified mail-line road and the 160 miles of electrified spurs and yards is mainly obtained from the hydro-electric power plant located at Great Falls, Mont. The power is delivered to the railroad at fourteen substations scattered along the route. The substations receive the electricity in 100,000-volt alternating current and deliver it to locomotives in 3,000-volt direct current; the 100,000-volt alternating current is received through oil switches, is conveyed to the high-tension current distributor made up of three lines of copper tubing, and there forms the source of power for the substation. From the current distributor the current is conducted through other oil switches to the transformers—entering at 100,000 volts and emerging at 2,300 volts.

The voltage being reduced, the next step is to change from alternating to direct current. The current is conducted from the transformers through switches to the motor-generator sets and is the power employed to operate them. Motor generators, of which there are either two or three in each substation, consist of one alternating-current motor driving two direct-current generators. The motor is of the sixty-cycle synchronous type, which means that the current changes sixty times each second. Each set generates a 1,500 or 2,000-volt direct current, and the two generators, being permanently connected in series, deliver a combined direct current of 3,000 volts, which is the highest voltage direct current adopted for railroad work in the world. By way of comparison, the direct-current voltage for ordinary street railway work is only 550 volts.

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After passing through the control switches, this 3,000-volt direct current is conducted to the feeder and trolley lines, and thence through the pantagraph for the operation of the locomotive. Each locomotive is equipped with two pantagraphs, one located at each end. The pantagraph performs the same functions as the trolley pole on the ordinary electric car.

A strong steel cable, called a catenary, runs just above the trolley wire and parallel to it all the way, and from this catenary the trolley wire is suspended by hangers at short intervals. In ordinary trolley construction crosswires strung between twin poles are the only support for the trolley wire. But in the catenary type, single poles each bearing a bracket support the catenary, and the catenary supports the trolley wire. While bracket construction is used on straight track, cross-span construction is employed on sharp curves and in the yards.

The trolley wires, of which there are two, are of 4/0 size. They are especially made for high-voltage electrical power use, and are the largest diameter copper wire employed for this purpose. This form of construction permits the collection of heavy current through the twin contact of the pantagraph with the two trolley wires, and assures sparkless collection under all speeds.

Under normal conditions, forty-two immense electrical locomotives are required to haul freight and passenger trains over the electrified mountain districts. These locomotives each cost approximately \$112,000; they weigh 284 tons each and will haul 3,200-ton loads trailing up a one per cent grade at an average speed of sixteen miles an hour. Similar electric locomotives geared for greater speed will haul 800-ton passenger trains over the same stretch of road at a speed of about twenty-five miles an hour, and on a level stretch at a speed of sixty miles per hour. The wood-burning loco-

motive of fifty years ago weighed twenty tons and had a tractive power of only 5,000 pounds. The present day Mallet steam locomotive has a tractive power of about 80,000 pounds, and the electrical locomotives weighing 284 tons have a tractive power of 85,000 pounds. These electrical locomotives are 112 feet, 8 inches long, and are driven by separate motors, twin-gearred to each of eight pairs of driving wheels. The cab extends for nearly the whole length of the locomotive.

Regenerative braking is a method used on down grades, by which the train, instead of consuming electricity, actually produces it while traveling onward, and by which, at the same time, the speed of the train is kept under perfect control.

This is the first use ever made of direct current regenerative braking, and the more clearly to explain its functions, the following is quoted from an authority on the subject.

Electric motors are reversible in their function; while they absorb electrical energy and give out mechanical energy going up grades, they can reverse this operation and absorb the mechanical energy given the train down grade by gravity and transform it into electrical energy. Thus the electric locomotive provides a perfect braking system, independent and separate from the air brakes, which are used only in emergency and for stopping trains. Electric energy so generated can be turned into the trolley wire to assist other trains.

In actual operation, at the crest of the grade, the helper locomotive is brought to the front of the train and coupled with the forward locomotive, the two being operated as one. The train is then controlled on the down grade by regenerative braking. This system of braking provides maximum safety, eliminates wheel, brake-shoe, and track wear and overheating, insures uniform speed on down grades, and returns electrical energy to substations to be utilized by other trains. From twenty-five to fifty-two per cent of power is thus recovered.

New York Central

A short description of the construction work in the Electric Zone of the New York Central will give an idea of the plant and equipment which the operating organization has to look after. The description is taken from an article appearing in the *Engineering News* during the construction period. The headquarters organization is indicated in Figure 2.

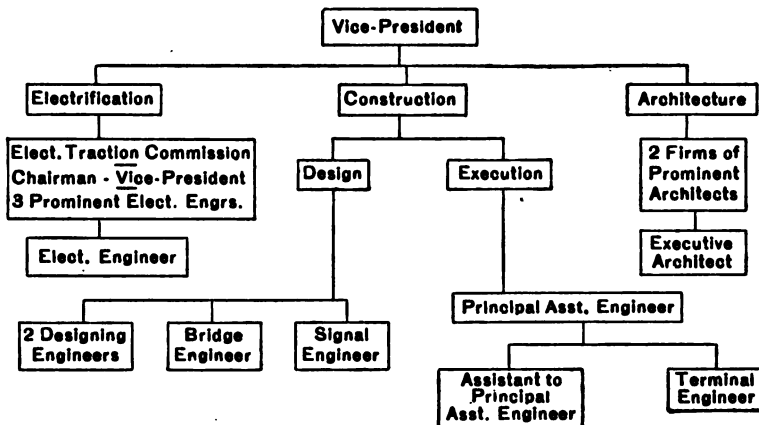


FIG. 2.—Construction Organization of Electric Zone and New York Terminal, New York Central Railroad

A map of the region over which the New York Central's terminal improvements extend is shown in Figure 3, in which heavy full lines have been used to indicate the divisions over which the electric operation has been installed, while other New York Central divisions are shown by heavy broken lines. Croton-on-Hudson on the main line or Hudson Division, and North White Plains, on the Harlem Division, are the terminal points of the electrical zone. Each division is four-tracked to these points, with two suburban tracks on the outside and two through tracks in the middle. On each division the suburban tracks are connected by a loop at the northern terminus. All tracks are equipped with a third rail, located outside the track. Electric current is supplied to the electric zone from two generating stations, one located at Port Morris, Borough of the Bronx, New York City; the other at Yonkers, N. Y., on the Hudson River.



FIG. 3.—Map of New York Terminal Lines and Electric Zone, New York Central & Hudson River Railroad

Roadway and Trackage.—The arrangement of tracks and conductor rails is exhibited in Figure 4, which is a cross section through the standard four-track roadway. The feature of prime interest is the conductor rail, an under-running protected third rail. The conductor rail is a bullhead rail, seventy pounds per yard, supported at intervals of eleven feet by cast-iron goose-neck pedestals, which are fastened each by three three-quarter-inch lagscrews to a long track tie. A two-piece porcelain insulator block, molded so as to surround completely the upper head and the web of the rail, is clamped in the pedestal and supports the rail. These insulators are six inches long, projecting one and one-half inches on either side of the pedestal, which is three inches wide; a forged strap, fitting over the block, holds it in place in the pedestal. Between insulators the rail is surrounded by a built-up wooden sheathing, whose cross section is similar to that of the insulator. Thus the live rail is protected along its entire length, leaving only the lower head of the rail projecting from the insulating sheath. Protection against interruption of service by sleet, ice, and snow has been aimed at in this design as well as protection to persons.

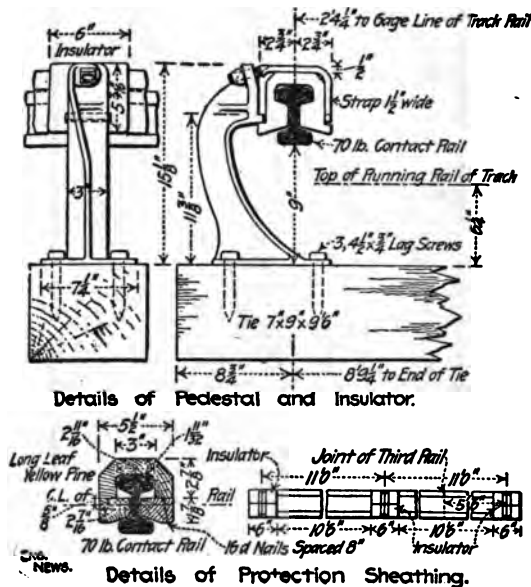


FIG. 4.—Cross Section through the Standard Four-Track Railway

At some special locations an overhead conductor is used in place of the third rail. In approaching such sections an auto-

matic device on the motor-car or locomotive depresses the contact shoes away from the third rail and lifts the overhead contact arm into place. The trackwork and third rail installation were done by the company forces.

The changes in trackage and structures include, beside complete four-tracking in the Electric Zone and installation of conductor rail, many improvements in alignment, the construction of interchange yards and repair shops at the terminals of the Electric Zone, the elimination of grade crossings at many points, the reconstruction of way stations in the Electric Zone, and the rebuilding of the Grand Central Station and Terminal.

At Croton-on-Hudson and North White Plains, the northern terminals of the Electric Zone, facilities are provided for the change from steam to electric locomotives, and vice-versa, for through trains, and suitable shops for necessary repairs to the electric equipment.

A complete new system of automatic signals in the Electric Zone, together with a comprehensive system of interlocking, was installed.

The frequent train service contemplated with the commencement of electrical operation rendered it absolutely essential for the safety of the public, and the efficient movement of the traffic, that all grade street crossings within the limits of the Electric Zone be abolished. This was accomplished at some points by means of overhead bridges; at others, by carrying the streets under the elevated tracks.

General

The electrification of isolated sections of the steam railroads will continue in special situations, such as in long terminals, in large cities, or on roads with heavy suburban traffic, but its general adoption need not be expected for some time to come. The cost of the work is great, which means that its use entails large additions to the capital account and in consequence large increase in the fixed interest charges on the additional capital. No doubt continued electric operation will develop certain economies not now possible, but for much the greater part of railroad traffic, steam operation will continue to be more economical when all the factors determining the

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net earnings after paying fixed charges are included in the comparison.

ILLUSTRATION OF ENGINEERING ORGANIZATION

The organization on all large roads embraces, of course, the officers doing the same work, but the titles and manner of reporting vary.

On the comparatively small Nashville, Chattanooga & St. Louis Railway System the chief engineer reports to the general manager and the department engineers to him. On the construction side, the resident engineers report through the division engineers (of construction) to the engineer of construction, who reports to the chief engineer. The signalmen report through the signal engineer to the chief engineer and also to the division engineer (of maintenance) on current operation. The timber and tie agent reports to the general roadmaster, who in turn reports both to the engineer and to the division superintendent.

Figure 5 summarizes this organization:

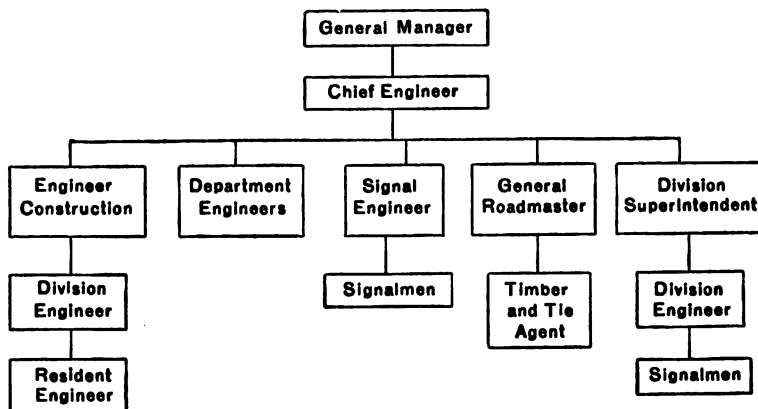


FIG. 5.—Engineering Organization of the Nashville, Chattanooga & St. Louis Railway

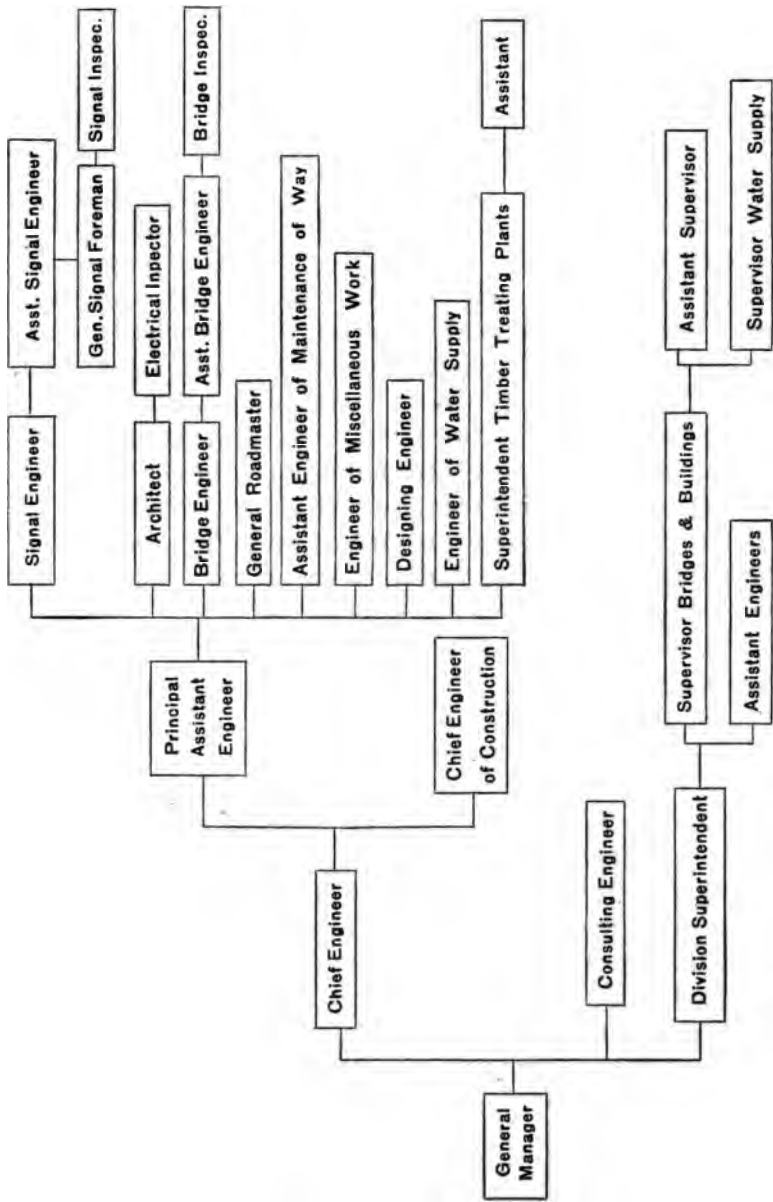


Fig. 6.—Engineering Organization of Louisville & Nashville Railroad

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The engineering organization of the Louisville & Nashville Railroad is shown in Figure 6.

It will be noted that the chief and consulting engineer report to the general manager, and that the chief engineer of construction and the principal assistant engineer report to the chief engineer. This principal assistant engineer is in charge of maintenance of way and has nine officers reporting to him, six of whom are engineers; viz., signal, bridge, maintenance-of-way (track and road-bed), miscellaneous work, designing, water supply. The architect, general roadmaster (track), and superintendent of timber-treating plants having direct responsibility for the execution of work report to him directly also. The supervisors of bridges and buildings and the assistant engineers (division engineers) report directly to the division superintendent on current operation, and to the assistant engineer of maintenance of way and bridge engineers on standards of maintenance.

The engineering organization employed in the largest systems is shown for the Atchison, Topeka & Santa Fe Railroad in Figure 7.

There is a chief engineer of the whole system reporting to the vice president in charge of construction and operation. There are four chief engineers reporting to the chief engineer of system on matters relating to standards of engineering work and structures and to the general managers on maintenance of way and other operating matters. The chief engineer at Topeka, Kan., has charge of 3,016 miles of lines; at Amarillo, Tex., of 3,844 miles; at Los Angeles, of 2,060 miles. At Prescott, Ariz., the chief engineer has charge of the Santa Fe, Phoenix & Prescott Railway, 403 miles. It will be noted that each of the three first-named chief engineers has charge of a constituent part of the system averaging 2,930 miles in length. They each have an assistant engineer in charge of maintenance and on the Coast

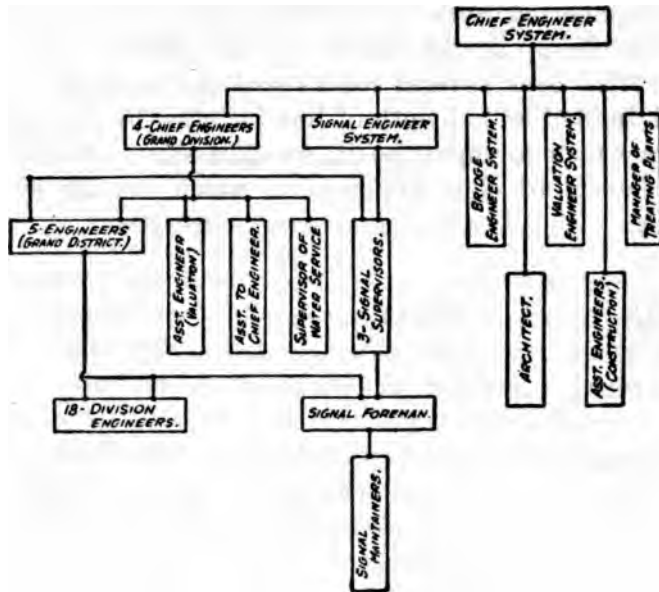


FIG. 7.—Engineering Organization of the Atchison, Topeka & Santa Fe Railway

Lines the chief engineer has an assistant in charge of construction in addition. An assistant valuation engineer and the supervisor of water service report to them, as well as three signal supervisors on matters relating to maintenance of signals.

The following *system* officers also report directly to the system chief engineer; viz., signal engineer, bridge engineer, valuation engineer, architect, and manager of timber-treating plants, and in addition assistant engineers of construction. All these except the last-named are staff officers charged with the design of work and establishment of standards.

This organization is based on the idea that matters of general policy and standards shall be under the control of *system* officers, and general uniformity of engineering practice is thus obtained; the actual performance

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of engineering work in accordance with such policy and standards is in the hands of line officers exercising authority over several constituent parts of the system, each limited as to length of line included by the capacity of one man to supervise it, which assures obtaining all the benefit of close supervision which smaller systems enjoy.

CHAPTER VI

OPERATION—THE OPERATING UNIT

The operating department is perhaps the one with which, through travel, the general public is most familiar and the one with which it comes in contact most frequently. So far as the traveling public is concerned, its demands are that it be furnished with an adequate and frequent service; that the operation of trains be surrounded with all the safe-guards possible; and that the equipment be such as to minimize the loss of life in the event of disaster. And, for the most part, such legislation as has been proposed or passed has for its aim the achievement of one or more of these ends.

The accomplishment of this purpose is one that requires an organization of the most minute and efficient kind.

To exercise the necessary personal or immediate supervision essential to safe conduct of transportation, the activities of the operating department are based on a combination of units, commonly known as divisions. The large systems which we now have are combinations of many of these units, the operation of which, except as to special situations, is fundamentally the same.

The limit of a division is determined by the operating conditions of the territory involved. There are two factors affecting this limit: distance and density of traffic. A division may be anywhere from 250 to 800 miles in length, depending on the two factors just named. In general, they are from 300 to 500 miles long. In the case of a terminal at a busy traffic center, however, the

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division may well be and frequently is confined to the terminal itself.

The following tabulation showing the operating divisions of the Atchison, Topeka & Santa Fe Railway, East of Albuquerque, furnishes a good illustration of this statement.

	Main line	Branch line	Total
Illinois Division	232.9	57.7	290.6
Missouri Division.....	213.5	79.3	292.8
Kansas City Division.....	Terminal		12.7
Eastern Division	218.5	198.2	416.7
Southern Kansas Division.....	347.8	344.3	692.1
Middle Division	261.9	360.1	622.0
Oklahoma Division.....	336.5	387.6	724.1
Western Division.....	251.8	285.9	537.7
Arkansas River Division.....	202.4	145.8	348.2
Panhandle Division.....	106.6	528.4	635.0
Plains Division.....	522.1	224.3	746.4
Pecos Division.....	240.0	54.3	294.3
Colorado Division.....	182.3	50.0	232.3
New Mexico Division.....	347.5	135.6	483.1
Rio Grande Division.....	307.6	116.5	424.1

DIVISION OF WORK

It may be stated that so far as divisional operation is concerned there are three main divisions of the work: first, the movement of trains or conducting transportation; second, maintaining the road bed, track, and structures, called maintenance of way; and third, maintenance of engines, cars, and other rolling stock, called maintenance of equipment. The officer charged with the operation and maintenance of a division is the superintendent. In American practice, the division superintendent has entire supervision of the maintenance of the road, maintenance of the equipment, and conducting transportation on his division. He controls the movement of trains through the trainmaster and the maintenance of equipment through the master mechanic.

Within the limits of his jurisdiction, he is for all practical purposes general superintendent during the absence of that officer.

The New York Central system of operating organization is the most notable exception to this statement. The essential differences between the American practice of vesting all authority of operation in the superintendent and the plan of distributing such authority between the superintendent and the mechanical and engineering departments will be subsequently discussed.

On an operating division 350 miles long with moderately heavy traffic, the organization for conducting transportation would be, say, two trainmasters; two or three dispatchers' forces, including station operators; yardmasters and crews at the ends of the division, at intermediate terminals, and at important junction points; station agents and station forces; train crews. The trainmaster reports to the superintendent directly; in some instances the dispatchers, yardmasters, and station agents report to the superintendent directly, in others through the trainmaster. The train crews report to the trainmaster in all matters pertaining to road operation, the enginemen under the supervision of the road engineer foreman to the master mechanic in mechanical matters.

In maintenance of way, the organization consists of, say, fifty section forces reporting to two roadmasters, either directly or through, say, four supervisors of track; the roadmasters reporting to the division engineer or superintendent; one foreman of bridges and buildings with carpenter, mason, and painting crews reporting to the division engineer; one division foreman of signals who in the case of block signals and many interlocking plants has charge of the signalmen at such plants and inspectors for the block signals, the foreman reporting to the superintendent and the supervisor of signals;

when only the simple station signals are in use the signalmen usually report to the division engineer.

In the maintenance of equipment, the organization consists of the enginemen under the supervision of two road foremen of engines as to operating conditions, and on locomotive maintenance under the engine-house foreman; one engine-house foreman with an assistant for night duty, to whom the various foremen at the engine-house report, as boiler maker, tankmen, air-brake men, machinist, blacksmith, tinsmith, toolers, carpenters, painters, hostlers, cinder-pit men, etc.; and the road engine foreman and the engine-house foreman reporting to the master mechanic, who in some cases has an assistant.

It is to be noted that the direct supervision of train movement is through the trainmaster; the direct inspection of the track is through the roadmaster; engine operation is directly supervised by the road foreman of engines; engine maintenance by the engine-house foreman.

The officers directly responsible to the superintendent are: the trainmaster for transportation; the master mechanic for equipment; the division engineer or roadmaster for track, roadbed, and structures.

If the railroad were only about the length of a division, this organization would attend to all details of operation. Without regard to density of traffic, five hundred miles of line is about the limit which one division organization can handle efficiently. As the traffic becomes more dense, the number of trains increases and the length of the division must decrease in consequence. At terminals of considerable size, efficient operation will require that the terminal itself be the operating division, for the reason that the movements of trains and switching crews are so frequent that they require very close

supervision to insure safety and to prevent the blockading of traffic.

The average length of a division on the Louisville & Nashville Railroad is 360 miles; on the Chicago, Milwaukee & St. Paul, 387 miles; on the Chesapeake & Ohio, 347 miles; on the Pennsylvania (largely four tracks), 244 miles. The following roads have longer divisions, the average for each system being as given: the Chicago, Rock Island & Pacific, 413 miles; the Chicago & Northwestern, 426 miles; the Chicago, Burlington & Quincy, 446 miles; the Atchison, Topeka & Santa Fe, about 417 miles; these latter roads have a large percentage of branch line mileage, which of course requires less supervision than busy main lines.

COMBINATION OF DIVISION UNITS—THE DISTRICT

On a railroad system about 1,500 miles long with average density of traffic, there are four or five *division superintendents*. Without supervision there would be four or five different kinds of operating organizations. No two divisions present operating conditions exactly alike, but certain general conditions are common to them all, and some one general plan of organization will be the best for all of them. The general superintendent or general manager will be the officer then to coördinate the work of these several divisions and make of the various separate units a smoothly operating machine with all parts adjusted one to the other.

If the system is still larger, there may well be several *districts*, each one different from the others but with conditions within each district practically uniform.

The Atchison, Topeka & Santa Fe is a great railroad system with 11,136 miles of main and branch lines, extending from the Pacific Ocean and the Gulf of Mexico on one hand to the Great Lakes at Chicago on the other.

While its trains in California are being loaded with tropical fruits and those in Texas with cotton, the operating department may be fighting blizzards in Colorado and Kansas, and snow in Chicago. On the eastern, western, and northern portions of the system the traffic is dense, and for miles in intervening desert territory there is scarcely any local traffic at all. On one portion of the system the engines use crude oil for fuel, on another Illinois "run of mine" coal. Several divisions will be operating snow plows while on other portions of the line they are applying oil to the roadbed to lay the dust. Where the line crosses the mountains there are sharp curves, stiff grades, and huge engines with one or more pusher engines to assist, and in the flat plains there is straight track, with easy grade, and comparatively light engines haul long trains unassisted.

From these circumstances arises the necessity for separating the system into major divisions and subdividing these into districts, comprised of several operating divisional units having the same general physical characteristics.

District Organization

The lengths of these districts will, as in the case of an operating division, be determined by the character of the traffic, with certain limitations as to length regardless of traffic.

The officer in charge of such an operating district is a *general superintendent*, and he supervises the operation of from three to five divisions, his jurisdiction extending as an average over 1,500 miles of line.

On the Atchison, Topeka & Santa Fe Railroad there are four general superintendents, fifteen division superintendents, and two assistant superintendents in charge of 6,770 miles between Chicago and Albuquerque, N. M., or an average of 451 miles per division superintendent

and 1,692 miles of line for a general superintendent's district; on the Coast Lines extending from Albuquerque west, one general superintendent in charge of a district of 2,042 miles, with four division superintendents.

The Chicago, Burlington & Quincy Railroad, with 9,140 miles of line, has five general superintendents with twenty division superintendents and eleven assistant superintendents reporting to them, an average of four division superintendents and about 1,800 miles for each general superintendent's district. On 5,368 miles of the Pennsylvania Railroad there are five general superintendents with twenty-two divisions and two assistant superintendents reporting to them, an average of about four division superintendents and 1,074 miles for each general superintendent's district.

The duties of a general superintendent relate to transportation matters—the movement of trains and the maintenance of the property. On smaller systems he has general charge of car accounting and distribution, but these duties are delegated to assistants. On many of the larger systems in the district organization, car accounting and distribution is under the supervision of the superintendent of transportation; general supervision of roadway and structures, under a resident engineer of maintenance of way; and general supervision over maintenance of equipment, under the mechanical superintendent. That is, in the district organization there are three main divisions of the operation just as there are in the small divisional unit, thus:

	DIVISIONAL UNIT ORGANIZATION	DISTRICT ORGANIZA- TION
Transportation	Trainmaster	Division superintendent
Maintenance of way	Division engineer	District engineer
Maintenance of equip- ment	Master mechanic	Mechanical superin- tendent
Signals	Signal foreman	Signal supervisor
Reporting to	Division superintendent	General superintendent

There are several arrangements of these district officers. On the Pennsylvania, the principal assistant engineer (maintenance of way) and the superintendent of motive power (maintenance of equipment) report to the general superintendent, the distribution and accounting of cars being through the superintendent of transportation; on the Union Pacific, all of them report to the general superintendent. The point to remember, however, is that there is some special officer in the district organization, whether he be an assistant in some other general officer's department or has a title of his own, who attends specifically to (1) movement of trains, (2) maintenance of road, (3) maintenance of equipment; and in addition there are special officers in charge of signals, water service, etc.

General Superintendent

This officer gets all the "tough" transportation problems that come up from his division superintendents. Much of his time is spent on the road in close contact with them. When he is responsible for the roadbed and equipment, this personal contact extends to the engineers of maintenance of way and mechanical superintendents as well. His relations in the district organization are much the same as those of the division superintendent in the smaller organization; he represents the general manager in transportation matters in all cases, and in some instances the chief engineer and the superintendent of motive power in the maintenance of way and equipment.

General Transportation Officials

The following extract from a letter of Mr. E. P. Ripley, president of the Atchison, Topeka & Santa Fe

Railway, indicates the duties of some officers on that road:

Superintendent of Transportation.—This officer reports directly to the operating vice president. He pays particular attention to the distribution of freight cars between system lines and keeps track of the movement of company freight cars over foreign lines and of foreign cars over company lines. He handles also the distribution of passenger equipment, including Pullman cars. He does not make distribution of cars direct to industries, this being handled by other operating officers.

Transportation Inspectors.—One inspector is employed on each division and reports direct to the general superintendent. These inspectors pay particular attention to the prompt movement of loaded and empty freight cars out of yards and from stations; to the condition of equipment, i. e., that no bad-order cars are set for loading and that cars in such condition are promptly so reported; to carload freight received from connecting lines; to loading of high-class freight, such as automobiles, in order to determine that the articles contained in the cars are properly braced. It is also the duty of these inspectors to see to it as far as possible that freight is billed out the day it is received. The proper keeping of station records and the economical use and requisitioning of stationery and supplies also are matters which receive their attention.

General Superintendent.—The duties of this officer are so varied that it is difficult to define them in a paragraph. He supervises all operating and maintenance matters in his territory, disposes of labor and general questions to the extent that his authority is final, and collects, condenses, and submits with his recommendation information as to any matters which require the attention of his general manager. Superintendents and transportation inspectors report to him direct.

On the Chicago, Milwaukee & St. Paul Railway, the general supervisor of transportation has charge of matters pertaining to demurrage and per diem; the superintendent of transportation has charge of car distribution; the car service agent has charge of all the records of car movements.

On the Chicago, Burlington & Quincy Railroad, the superintendent of transportation has charge of the movement of all cars over the entire system, his principal

duty being car distribution. The general inspector of transportation attends to various duties relating to the arrangement of train schedules and to the supervision of train rules and the examiners who examine trainmen on rules, and reports to the Interstate Commerce Commission on personal-injury cases, violations of the "hours of service" law, and other transportation features on which the Commission requires reports. He also has various special duties which are assigned him from time to time.

On the Pennsylvania Railroad, the general superintendent of transportation has general supervision of the movement of all traffic—passenger and freight—and of the distribution of cars, being in effect an assistant general manager in charge of transportation with specific authority over car service; reporting to him are the superintendent of freight transportation, who is in effect a freight traffic representative in the operating department, having charge of car distribution to the freight stations; and the superintendent of passenger transportation, who performs the same service for the passenger department.

On the Louisville & Nashville, the superintendent of transportation represents the general manager in the transportation department and has charge of car distribution.

Mechanical Superintendent

This officer's supervision is about the same in the matter of maintenance of equipment in the district organization as that of the general superintendent in matters of transportation. On the Atchison, Topeka & Santa Fe Railroad, eighteen master mechanics report to four mechanical superintendents, or from four to five master mechanics to each superintendent, and the

superintendents report to the assistant to the operating vice president in mechanical matters.

District Engineer

The same statement may be made as to the district, resident, or principal assistant engineer, as he is variously called. He represents the engineering department in the district organization, whether he reports to the general superintendent or to the chief engineer of maintenance of way.

Signal Supervisors

A signal supervisor has supervision of the maintenance of all signals in his district, the division foremen of signals reporting to him. He reports to the general superintendent on maintenance and operation of signals and to the signal engineer on standards. His jurisdiction extends over the same territory as that of the general superintendent.

Superintendent of Water Service

On many of the western lines the matter of a supply of good water for locomotive and shop use is a serious one. Much of the available water contains ingredients which injure the boilers and interfere seriously with efficient operation. This is true also to a limited extent of water in other portions of the country.

Such water is treated with various chemicals in plants especially designed for the purpose. It often involves the construction of large water-storage facilities as well. The general supervision of such work in each district is delegated to a superintendent of water service who reports to the general superintendent.

General Roadmaster—Track Inspector

The duty of this officer is the general supervision of track through close contact with the division roadmasters. His jurisdiction extends over a general superintendent's district and he reports usually to that officer.

MAJOR DIVISIONS

The largest systems are separated into *major divisions* which are under the supervision of *general managers*.

The New York Central proper divides its 5,032 miles into Lines East of Buffalo and Lines West of Buffalo, with a general manager, reporting to the vice president, in charge of each major division. The Lines East include Districts 1 and 2 and the Electric Zone; Lines West include Districts 3 and 4, each district being in charge of a general superintendent.

The Chicago, Burlington & Quincy Railroad (9,140 miles) and the Chicago & North Western Railroad (8,090 miles) divide their systems into Lines East of the Missouri River, and Lines West of the Missouri River, with a general manager and assistant general manager in charge of each. On the Chicago, Burlington & Quincy Railroad there are three general superintendents on Lines East, and two on Lines West; on the Chicago & North Western Railroad there are one general superintendent and two assistant general superintendents on Lines East, and two general superintendents on Lines West.

On the Union Pacific System (7,801 miles), composed of the Union Pacific Railroad (3,611 miles), Oregon Short Line (2,062 miles), and Oregon-Washington Railroad & Navigation Company (2,023 miles), there is a

general manager in charge of each constituent system, with an assistant general manager on the Oregon Short Line and two on the Oregon-Washington Railroad. Each of the three general managers has a general superintendent or a superintendent of transportation reporting to him.

The Atchison, Topeka & Santa Fe Railroad proper is composed of four major divisions: Lines East (3,004 miles), extending from Chicago to Newton, Kan.; Lines West (3,767 miles), extending from Newton to Albuquerque, N. M.; Coast Lines (2,042 miles), extending from Albuquerque to the Pacific Coast Terminals; and the Santa Fe, Prescott & Phoenix¹ Lines (401 miles), extending from the Main Line to Phoenix, Ariz. Each of these four major divisions is in charge of a general manager with an assistant. The Lines East are subdivided into Eastern District and Western District, and Lines West into Northern District and Southern District, each district being in charge of a general superintendent as heretofore noted.

General Manager

The general manager on the Pennsylvania System is charged with "safe and economical management of the road," which is a pretty large order for any man. He advises the operating vice president and the board of directors in all matters pertaining to the operation of the property, and submits such plans for improvements as his actual contact with the working organization suggests.

¹ Extract from letter of Mr. E. P. Ripley, president of the A. T. & S. F. System:

"The Santa Fe, Prescott & Phoenix Lines were originally operated independently, and so far its old organization has served our purposes better than an attempt to bring it directly into the Coast Lines."

He formulates the rules and regulations governing all operating officials and employees, and is responsible for the discipline of the entire department. He is responsible for the conduct of transportation—movement of trains—in all cases, and in most organizations for the engineering and mechanical departments through the chief engineer and superintendent of motive power. One of the principal, and perhaps the most trying, of his duties is the handling of the labor question with the several labor organizations of railroad employees.

He has the power of appointment of all officials in his organization and must in consequence maintain a clear, accurate record of each officer's performance with a view to general efficiency through well-considered promotion or elimination. He sometimes purchases machinery, tools, equipment, and such material as rails, but not the ordinary current supplies, which are bought through the purchasing department.

As just stated, the general manager in all organizations is responsible for conducting transportation; on some systems he has general supervision of the engineering and mechanical departments through the chief engineer and superintendent of motive power reporting directly to him; on others these engineering and mechanical departments are under the control of a chief engineer and superintendent of motive power reporting to the vice president, their operation being independent of the operation of the transportation department.

There are fundamental differences between certain organizations that will be discussed in connection with the diagrams of the operating departments of two large systems.

EXAMPLES

Figure 8 is a skeleton diagram of the New York Central organization. All the officers are not shown, the

OPERATING DEPARTMENT

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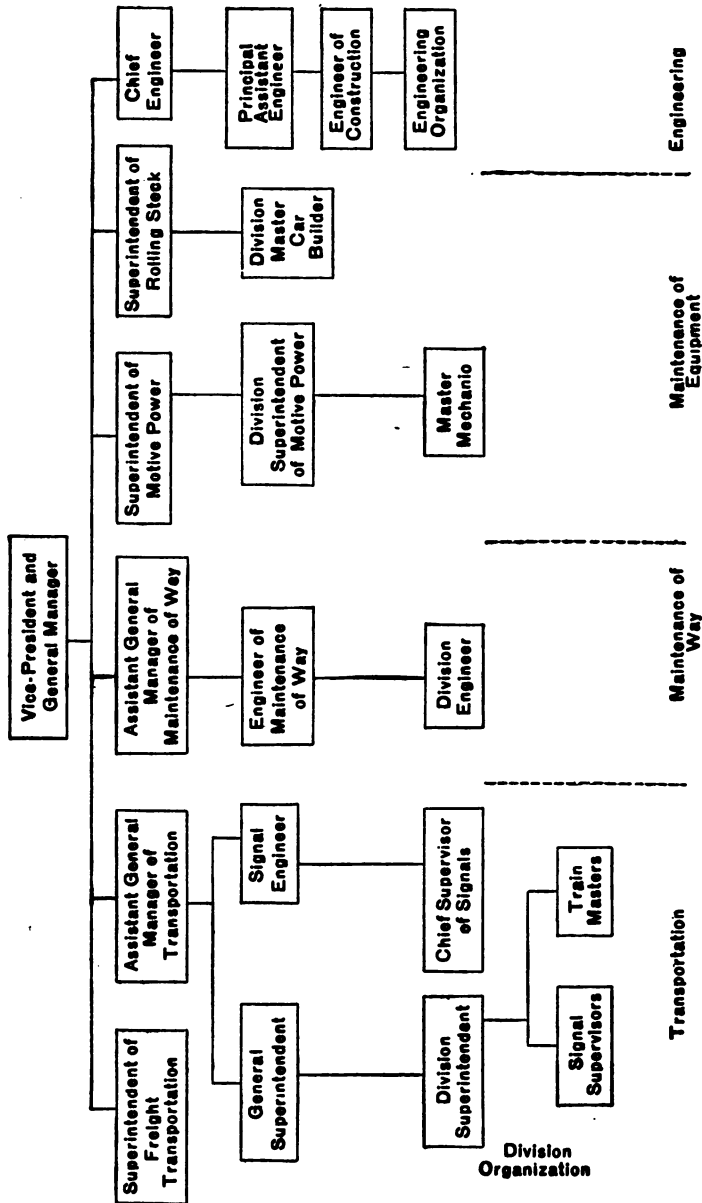


Fig. 8.—Skeleton Diagram of the Operating Department of the New York Central Railroad

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purpose of the diagram being to indicate how the officers in the transportation, maintenance-of-way, and maintenance-of-equipment divisions of the operating department report.

In the division organization it will be noted from the diagram that the division superintendent has charge of transportation—movement of trains and signals—and reports to the general superintendent. The division engineer has charge of maintenance of way and reports only to the engineer of maintenance of way. The master mechanic has charge of maintenance of equipment and reports direct to the superintendent of motive power. That is, there are three officers in charge of the division organization, each of whom reports to his own department.

In the district organization the general superintendent is in charge of transportation and reports to the assistant general manager of transportation. The engineer of maintenance of way is in charge of that work and reports to the assistant general manager of maintenance of way. The division superintendent of motive power in charge of maintenance of equipment reports to the superintendent of motive power. In the district, as in the division organization, there are three officers in charge, each of whom reports to his own department.

That is, through the entire operating organization, the division of authority and supervision is on the basis of the character of the work. It will be noted that the maintenance of equipment is composed of two separate divisions, one having charge of motive power (locomotives) and the other of rolling stock (cars).

The engineering organization, except for the engineers connected with maintenance, is entirely separated from the operating department except in the headquarters staff.

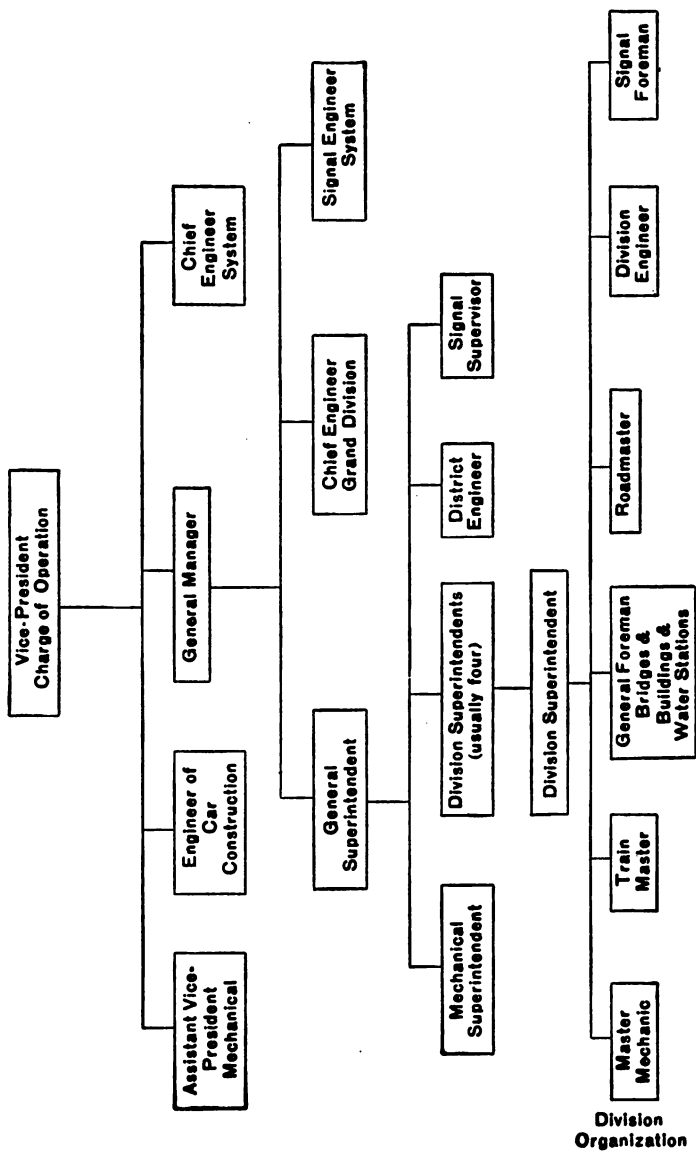


FIG. 9.—Skeleton Diagram of the Operating Department of the Atchison, Topeka & Santa Fe System

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This is a strictly departmental form of organization throughout.

Figure 9 is a skeleton diagram of the Atchison, Topeka & Santa Fe operating organization. Its purpose is to show how the officers in the transportation, maintenance-of-way, and maintenance-of-equipment divisions of this department report, and for that reason all the officers of the department are not shown.

In this organization the trainmaster, master mechanic, division engineer, signal foreman, foreman of bridges and buildings, and roadmaster report to the division superintendent. That is, he has supervision over transportation, maintenance of way, and maintenance of equipment and is in consequence a general manager on his own division.

In the district organization, the division superintendents (transportation), the mechanical superintendent (maintenance of equipment), the district engineer (maintenance of way), and the signal supervisor report to the general superintendent, who is in consequence a general manager in his district.

The general superintendent and the chief engineer (of major or grand divisions) report to the general manager.

This is a strictly divisional form of organization throughout.

The master mechanic and the mechanical superintendent, although reporting to the division and general superintendents on operating matters, are responsible to the mechanical department as to all matters relating to the standards it establishes. The same is true as to the engineers and signalmen in relation to the engineering department.

CHAPTER VII

OPERATION—CONDUCTING TRANSPORTATION

FREIGHT TRAFFIC

Since the term transportation contemplates the receipt and delivery of freight and passengers, loading and unloading freight from and into cars, assembling these cars into trains and moving the trains over the division, it seems logical to follow through the activities of the department in the order in which they come in contact with the shipping and traveling public.

The first officer of the organization with whom the shipping public comes in contact is the station agent, who with his assistant receives or delivers the freight, handles passengers, and supervises weighing, loading, and unloading freight from and into the cars.

Local Agent

The local agent is the man on the railroad with whom the public comes most in contact and the opinion his neighbors have of him is apt to become their opinion of the company. His realization of this will inspire him with a determination to maintain the good name both of himself and of his company. Uniform courtesy in dealing with the public should be the rule of every railroad officer and employee, but it is of supreme importance to the local agent, for discourteous treatment may lead a shipper to give his business to a competing line or to short-haul that of the man who has offended him.

He must, however, be a versatile man. In addition to having the qualities which make for success in the management of a general merchandise store he must usually be a telegraph operator, a rough and ready lawyer, a first-aid surgeon, a substitute

for a certified public accountant, a pretty good bank president, a political economist, a peacemaker, a captain of men in action, and an organizer of victory. He must interpret and do his best to enforce a multitude of detailed and regulating authority as well as those which originate at the railroad headquarters. He must have a patience and good humor which will qualify him for a robe and a harp and a seat in heaven alongside of Job himself, and, with all this, he must be a self-respecting citizen, a church member, and rear a family on a modest wage.

There are three requisites for advancement in railroad service—loyalty, efficiency in your present job, and preparedness for larger responsibilities. Efficiency and preparedness for higher place go together, for that man will be most efficient in his present job who is not content with mere mechanical performance of his duties, but who has an intelligent understanding of them in their relation to the service as a whole, and who has qualified to take over the duties and responsibilities of his immediate superior on a moment's notice. Applying this to the local agency, it follows not only that the agent should be a man measuring up to these requirements for advancement, but that he should carry out the principle in the organization of his force.¹

The station agent, when an operator, is to that extent under the supervision of the dispatcher. In addition, he reports to the auditing department in all matters relating to the collection of freight and passenger charges, and to the traffic department in all matters relating to the securing of freight. He supervises the loading and unloading of all freight (and baggage, except at large terminal stations), receipts for it, collects all charges due, and makes the way-bills for its proper forwarding. In connection with passenger traffic he sells tickets, checks baggage, and collects excess charges on it when due. He is responsible for the care and maintenance of the station buildings and grounds.

He reports to the dispatcher daily, by wire, the various cars on the tracks at his station. To the auditing department he reports daily or weekly the total

¹ Address by Fairfax Harrison, president Southern Railway, June 20, 1916.

amount of freight charges on all way-bills received at or forwarded from his office, distinguishing local from interline traffic; if located at a junction, on all bills for freight in which his road is an intermediate carrier. He makes also a report on milling and cleaning grain in transit and various summaries and monthly reports, including statements of switching and car-service charges. Agents at coaling stations report to the fuel accountant, separately, all coal received, delivered to engines, and rebilled. The agent reports to the claim agent any fact as to the condition of a shipment or form of a way-bill that may give rise to a claim. Being held responsible for the collection of the correct amount of all charges on freight received at his station, he obtains a ruling from the traffic department or auditor on questions of a doubtful classification or rate before settling on way-bills for goods received or on prepaid freight; he reports any cars at his station in bad order to the trainmaster.

Where the traffic department has no solicitor in the city or town in which he is located he acts in that capacity, advising the traffic department of proposed or possible movements of both in and out bound freight at his station, since through his intimate relations with the shippers he is often well advised of much prospective business.

He reports to the legal department the receipt of legal notices or garnishments of employees' wages. He reports to the superintendent all untoward events, as sudden and violent storms or floods, fires in his city, or destruction of company property.

His relation not only with the general public but with the various other departments is more intimate than that of any other railroad employee.

Freight Stations and Facilities

The freight station service at terminals is under the direction of the agent. At large stations the passenger business is entirely separated from the freight, and under the direct supervision of the stationmaster. The agent's duties relate to freight-house and team-track operation and to the switching of cars to and from various locations under his immediate jurisdiction.

A description of the handling of out-freight at the Illinois Central South Water Street station, at Chicago, is given in *Railway Organization and Working* by Professor E. R. Dewsnap, which gives a very clear idea of the work and organization involved in freight-house operation. The following matter is written from information contained in that work.

The freight-house proper is of brick, one thousand feet long and forty-eight feet wide; extending from it to the south is a covered platform six hundred feet long and twenty-five feet wide. The freight-house proper has forty-three receiving doors, in front of each of which is located a five-ton-capacity scale for weighing freight received from the tail-gates of trucks and wagons. The offices of the receiving clerks are so arranged that each office takes care of two doors.

There are seven tracks along one side of the house and platform with a total capacity of 238 cars. For convenience in operation the house and platform are divided into three sections, each a little more than five hundred feet in length, the point of division being called a relay. One man with three or four helpers is stationed at each relay point to take care of loaded trucks moving between the three sections. The object is to confine the truckers to the section to which they are assigned, eliminating the necessity of a truckman's trucking his load extreme distances; the trucker brings

his load to a relay, leaves his loaded truck, and takes back a truck destined to a car in his section.

Freight-House Organization

The organization of this house-force consists of the following:

A general foreman supervising both the out-bound and in-bound freight-houses.

An out-bound foreman having charge of that freight-house and reporting to the general foreman, with an assistant out-bound foreman under his immediate jurisdiction.

Two relay men with four assistants handling freight at the divisions of the three sections.

Thirty-four receiving clerks and thirty-four scale men at receiving doors.

A routing clerk assisting the receiving clerk in proper routing.

Thirty stowmen, one to each seven or run of cars. These stowmen place the metal bridges or runways and fasten the doors of cars when loaded or at the end of the day.

A sufficient number of truckers (the number varying with the amount of business) divided into gangs of three and distributed to various receiving doors.

Two messenger boys carrying shipping tickets from the receiving clerks to the office to be rated and billed.

Two carders and sealers who card all cars on house-tracks and seal them at the close of the day, the actual sealing being done by a force of fifteen men at night. The sealers record the number and kind of seals applied to the various doors and windows of the car.

A special policeman on the driveway directing teamsters to proper receiving doors.

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The average daily business handled by the force is given as 2,000,000 pounds of out-bound freight, transfer freight averaging 1,400,000 pounds.

Team Track Organization

For the accommodation of shipments that move in carload quantities and less-than-carload shipments of such articles as it is inexpedient to try to handle through the freight-house, team tracks are provided with space between them for a roadway over which trucks or teams may be driven and in which they may stand while loading and unloading cars. The switching crews usually "pull" these tracks two or three times a day, taking out loaded cars for out-bound movement and placing empties or loaded cars to be unloaded or loaded as the case may be, as required and directed by the agent. As a general rule the shippers do their own loading and unloading at such tracks.

The agent or delegated subordinate attends to the way-billing of out-bound cars and the collection of charges on in-bound cars, keeping a record of the movement of all such cars. The collection of charges and transmission of money to the treasurer, the payment of time checks for station employees laid off, the preparation of drafts for foreign lines, and such duties, are attended to by the cashier who reports to the agent.

Office Organization

The preparation of way-bills, orders, and reports is divided among the office force, the total number of clerks assigned to this particular work of course being proportioned to the volume of business. Usually in large offices certain clerks are assigned to the way-billing of particular classes of traffic such as merchan-

dise, live stock, coal, company freight, etc. Other clerks are assigned to the making of freight bills against consignees, making bills for car service, switching, and incidental service, and sending notices to consignee of the arrival of freight. Still others make abstracts of way-bills required for local and for interline shipments and card way-bills, statements of company material, and numerous other reports, bills, and orders.

The statement of work to be done and subjects to be covered indicates the character of the organization required, which, as stated, varies with character of the traffic and its volume. At small stations, an agent with one or two assistants may perform at different times all the duties relating to the receipt and forwarding of freight, while at large stations the agent may require large forces of clerks in the preparation of the various bills, records, and reports required.

Yardmaster

This is the agent having such service as the loading of the property and sealing of the cars. It is then necessary to place these cars in various trains in order that they may reach their billed destination or junction point at the earliest possible date. This to a large extent devolves upon the yardmaster.

The yardmaster is in charge of all switching operations within defined yard limits, the assembling of outgoing and breaking up of incoming trains. He supervises the assembling of various cars into trains of the several classes to which they belong. That is, he segregates fast freight, slow freight, and local freight into trains operated for these several kinds of freight service. The cars are divided into their various kinds, those going toward any other trains of different classes, those to be switched to freight sheds, industrial tracks or team-

tracks, those to be forwarded over connecting lines, and those to be sent to local stations by intermediate stations.

Terminal Yard Operation

Terminal yard operation is under the control of the general yardmaster and, according to the size of the yard, he may be aided by several assistant yardmasters. The work involves the handling of trains and cars and making proper records relating to them. This consists of receiving and forwarding trains and contains for the yardman, the following units, which he must handle:

Cars (1) to be forwarded in other trains, (2) to be held for orders, (3) for freight-houses, (4) for team tracks, (5) for private or industrial sidings, (6) for connecting lines, (7) for storage, (8) company material, (9) those for weighing or reweighing, and (10) the transference of the contents of bad order cars into sound equipment.

In addition to cars received from incoming trains, he has charge of others received from the terminal freight houses, team tracks, and industrial tracks of the company as well as the cars received from connecting lines.

In making up trains, the factors to be considered are: destination; character of freight as fast, time, or slow freight; character of trains as local, through, or special. The routing rules, train schedules, and methods of handling special-service cars determine the trains in which cars shall move.

In order to facilitate this breaking up, classifying, and making up of trains and cars, large yards are provided with the following sub-yards, connected one with the other:

Inbound yard
Classification yard
Outbound yard
Repair yard (near classification yard)
Storage yard (alongside of classification
or outbound yard)

The cards showing the classification of the car, attached by the carder in the inbound yard, furnish the information required in disposing of all cars. These cards show in addition the date of arrival of the car in the yard, contents, and consignee, which information affords a means for avoiding undue delay as the yard-master on inspection will give special attention to cars whose cards indicate undue "age" in the yard.

Between the inbound and classification yards there is in many of the more modern yards a hump. The switch engines push the cars over this hump and they move by gravity to designated tracks in the classification yard. A description of the operation of the Chicago, Burlington & Quincy yard at Galesburg, Ill., in the *Railway Age Gazette* of July 3, 1914, reads:

Hump engine foreman cuts the cars off and works from ten to fourteen hump riders, with one switch tender at the divide (hump), one at the cross-over and one on each lead (switch for different tracks in classification yard). Cars must be stopped at least two feet from cars standing on track they ride in on. This saves damage to cars. The yard is provided with sufficient fifty-pound skid shoes (to slacken speed of car) to catch cars that get away from the riders.

After being separated into the several classes as indicated by the attached cards, the cars are taken by switch engines to their various destinations. Those intended for out-going home-line trains going to the out-bound yard are transferred to the connecting lines and others to freight houses, industrial, and team tracks, or repair and storage tracks.

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Some figures in regard to the number of cars handled in the Galesburg yard will be interesting: The track capacity of the yard is 8,979 cars; there are 72 different classifications of cars; all cars leaving the yard are made up in the outgoing train in destination order; there are 76 regular passenger and 130 freight trains per 24 hours or an average train movement every 7 minutes; there are normally 32 switch engines at work in the yard; the record car movement through the yard in 24 hours is 7,300 cars and an average of 6,800 cars per 24 hours for a 90-day period.

The assistant superintendent of the Chicago, Burlington & Quincy at Kansas City, Mo., has this to say in regard to yard organization:²

The organization of forces should provide for a general yardmaster, both day and night, assistant yardmasters day and night on the hump, and (in city yards), an inside or desk yardmaster days and an outside yardmaster nights, a chief clerk day and night, bill, manifest, and diverting clerks, and car checkers. The assistant yardmaster should be in charge of the hump and trimmer engines and the engines in the departure yard. The desk yardmaster should be in telephone communication with all parts of the yards and departments keeping in direct touch with them and should adjust the slack and congestion in the different yards, directing the power from one direct to another.

It is evident from this description of the work to be done and the example given of the switching crews employed in the Galesburg yard that a very thorough supervision of yard work is necessary to prevent interference between crews and consequent loss of time. Certain crews are usually given the same assignment; that is, switching the industrial tracks in a certain district, or team tracks, inbound and outbound freight-houses, elevators, or transfer of cars to certain con-

² Article by Mr. O. C. Hill, assistant superintendent, Chicago, Burlington & Quincy Railroad, in the *Railway Age Gazette*, August 21, 1914.

nections. A system of dispatching carried on over the telephone is usually necessary to adjust the work of the switching crews to a business which varies in character and volume from day to day.

Train Dispatching

The cars, having been assembled into trains at various classification yards under jurisdiction of the yardmaster, are now ready to go forward. The officer directly concerned with the movement of trains over the division is the trainmaster, whose duties consist principally in watching and studying the work of trainmen, judging their fitness, and observing locomotive performance in actual service. In consequence, much the larger part of his time is spent outside along the roads under operation. His office duties are of considerably less importance.

He directs all train operations through the train dispatcher. His connection with the mechanical department as to locomotive performance is necessarily intimate as well as with the division engineer with regard to the condition of track.

One feature of operation which usually occupies a very large portion of his time, particularly when the movement of traffic is at or above normal, is the condition of the yards at terminals and important junction points. The avoidance of blockades in such situations is one of the particular duties with which he is charged, and any tendency toward such blockade conditions is reported at once to his superintendent. The trainmaster, in conjunction with the agent, also has charge of all switching crews through the yardmaster.

On some roads, notably the Union Pacific, such station agents as are telegraph operators, and all other telegraph operators, report to the trainmaster. This is

true also of the chief dispatcher, dispatching operators, and other division office telegraph operators. It is to be noted also that enginemen and trainmen report to the trainmaster on matters relating to train operation; in addition, the enginemen report directly to the road foremen of engines and the engine-house foremen and certain train conductors report to the auditing and treasury departments.

The Chief Train Dispatcher.—Orders for the actual movement of trains are given by the chief train dispatcher who is held directly responsible for their safety. In this he is assisted by subordinate train dispatchers or dispatcher operators, each dispatcher taking an eight-hour "trick."

The Train Dispatcher reports to the chief dispatcher. He issues orders for train movements over the particular division to which he may be assigned and sees that they are properly transmitted and recorded, keeping a record showing the time when each train passes each telegraph station, the time when each dispatcher goes on and off duty, and important facts incidental to train movements. He is responsible for the conduct of the office in the absence of the chief dispatcher.

The Telegraph Operator generally reports to the chief dispatcher and in his absence to the train dispatcher. At larger stations an operator is under the direction of the agent or stationmaster, and at yards of the yardmaster.

All operators along the division report and keep and register the exact time of the arrival, departure, or passing of each train, giving its engine and train number. This information is tabulated as received, and the location of moving trains is thus known at the dispatcher's office at all times by telegraph or telephone or direct through the operators located along the line, the meeting points of all trains often dictating the

speed at which trains are to run between certain designated stations.

Through call boys he notifies the trainmen to report for duty and is to this extent charged with the responsibility of having full train crews in advance of the time of departure of trains.

He receives reports from the operators and agents of the number of all loaded, loading, and empty cars of all classes of his division, reporting in turn to the car accountant and superintendent.

The Lineman reports to the chief dispatcher and conforms to the instructions of the line foreman. He inspects the wires, poles, and insulation and makes all necessary repairs to telegraph and telephone lines, calling on the track foreman for assistance when necessary.

The Engineer reports to the road foreman of engines and is subject to the orders of the trainmaster as to train movement and stations, of the yardmasters at stations and yards, and of the conductor as to the stopping and starting of trains. At the engine-house he is under the direction of the engine-house foreman to whom he reports at the end of each trip as to the engine's condition. He calls the indications of signals to the fireman and head brakeman.

The Fireman reports to the road foreman of engines and is subject to the orders of trainmasters as to train movements. At the engine-house, he is under the direction of the engine-house foreman and while on duty obeys the orders of the engineman.

The Freight Conductor reports to the trainmaster and is subject to the orders of the station or yardmaster within yard limits. He is responsible for the movement, safety, and care of his train and the conduct of his trainmen. He must show his train orders to his enginemen and brakemen. He is charged with the inspection of his train and all cars therein before starting and as

frequently during his trip as circumstances allow. He is not allowed to move cars without proper way-billing.

The Freight Brakeman reports to the trainmaster and is subject to the orders of conductors and yardmasters. On local freight trains he assists in loading and unloading freight. He is required to inspect the brakes, ladders, running board, and all mechanical appliances he uses, and is responsible for the care and display of signals. The rear brakeman protects the rear and the head brakeman the front of the train by flagging against other trains.

CHAPTER VIII

OPERATION—CONDUCTING TRANSPORTATION—Continued

PASSENGER TRAFFIC

At the more important centers throughout this country, passenger and freight traffic are segregated and operated as distinct units of the service.

In large metropolitan centers, passenger traffic has assumed such proportions as to necessitate the erection and construction of the most elaborate terminals. The number of passenger trains moved into and out of the terminals is so large that separate supervision for passenger-train operation is required. The operation of the Chicago and Northwestern Railway passenger terminal in Chicago is typical of such a condition, and a description of the organization and methods will serve to illustrate this feature of terminal operation.

Chicago is the eastern terminus of ten thousand miles of this system. It was the first railroad constructed in the West, the first construction (in 1848) being that of its present Galena division. Over its own lines it now reaches the northwestern states and in connection with other systems touches all important points west, northwest, and southwest of Chicago as far as the Pacific Coast, which necessitates the operation of a very large number of trains. In addition it operates a very extensive suburban passenger business between Chicago and outlying points.

The total number of scheduled passenger trains is 315 daily—the normal passenger movement through

the station being 60,000 daily. During a strike on the surface and elevated lines of the city, however, the total number of trains reached as high as 500 daily with 150,000 passengers handled.

During the periods of normal maximum traffic—seven to nine A. M. and five to seven P. M.—there is a train movement at intervals of 100 seconds (1 $\frac{2}{3}$ minutes). The entire terminal operation is under the direction of the superintendent of passenger terminals.

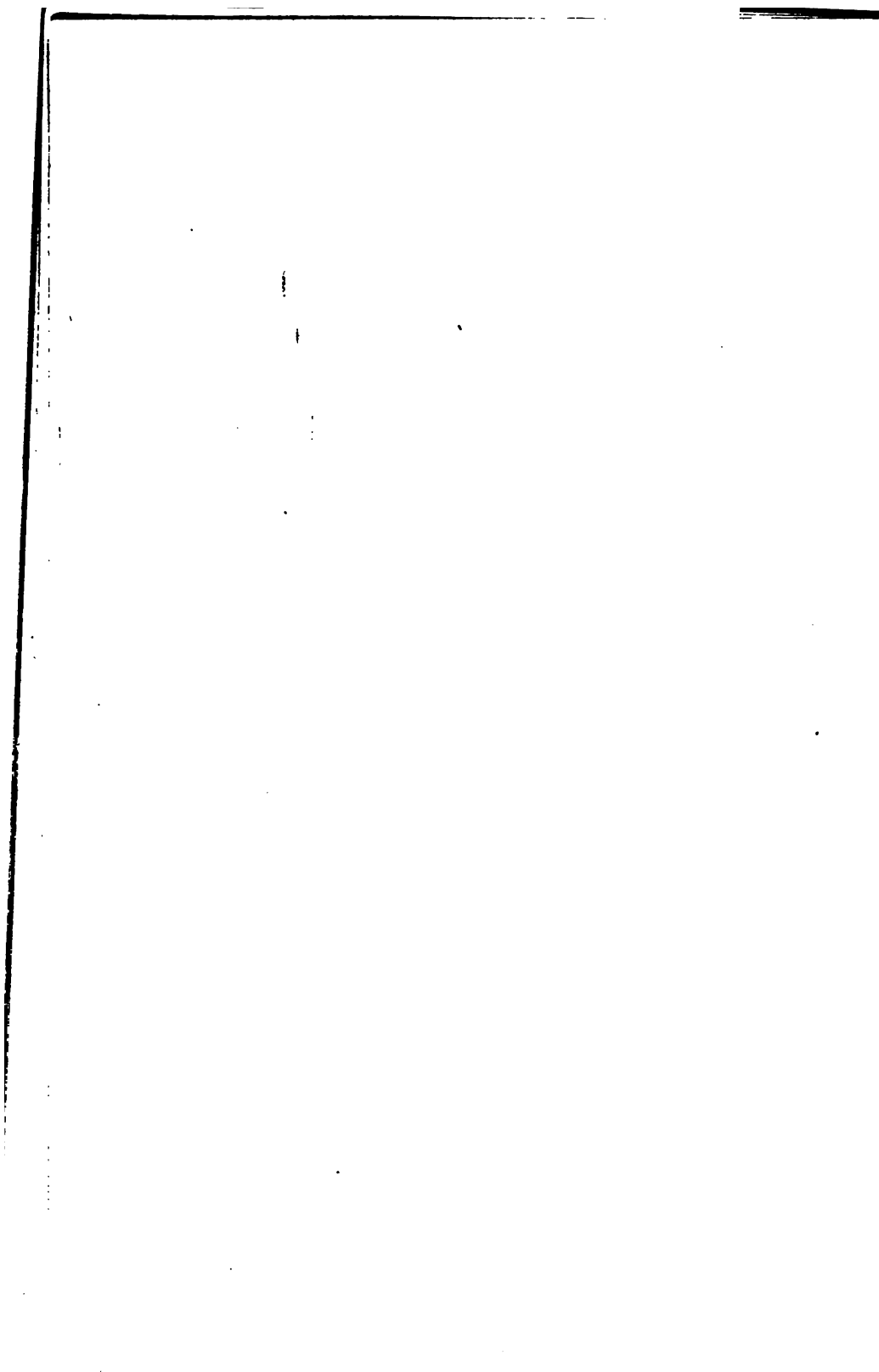
Train Operation

The train crews and the yardmaster report to the trainmaster. The principal work of the switching crew is the handling of baggage cars, mail cars, and express cars between the points of loading or unloading and the trains in which they move. Some trains are handled wholly by the switch engine, but usually trains between the passenger terminal and the coach yards are handled by their own engines.

The terminal is provided with its own telautograph¹ and telephone service. By means of the former the different departments at the station are advised at all times of the position of all trains moving into the terminal. Recording instruments are located in the superintendent's office, on the floors of the waiting rooms for train announcers, in the dispatcher's office, mail, baggage, and express rooms, and at other points.

¹ A message written in long hand at any sending instrument is reproduced at all receiving instruments in long hand. A sample record reads "321/2," which means train No. 321 is arriving on track No. 2. Any special feature in regard to a train may also be sent as "321/2 with 500 sacks of mail for L. S. & M. S.," which means that train No. 321 arriving on track No. 2 carries 500 sacks of mail for the Lake Shore & Michigan Southern Railroad's eastbound train, which is advice needed by the employees operating the belt conveyors from the lower floor and by the laborers and truckmen engaged in handling and transporting it promptly to the terminal of that road.







The telephone is used in communications among various employees and as a reserve in case of temporary derangement of the telantograph.

The following instructions to gatemen, conductors, and towermen are printed in the terminal time table and explain the method of train operation within the terminal limits:

Conductors, Gatemen, and Towermen's Signal System for Starting of Trains

The signal system for starting trains is composed of two lights and a push button at regular intervals on train shed posts for use of conductors, two lights and a push button near gate for use of gatemen, and three lights and a push button on train indicator board at Lake Street tower² for use of towermen.

The signaling system is used for all departing train movements from the depot, whether scheduled, extra, or empty.

For Departing Through Trains.—One minute before the departing time of a through train, conductor will press push button nearest the track from which the train is about to leave. This will cause the top light to appear in towermen and gatemen's indicator and is an indication that the train is ready to depart on time. When towerman is ready to handle train he will press a push button, which will cause the second light to appear in the tower and gate indicators and top light in conductor's indicator. At departing time of train the gateman will close gate and immediately press his push button, which will cause the lower light to appear in conductor's and towerman's indicators. This is an indication to conductor and towerman that all passengers have passed through the gate and gate is closed. The train may then proceed, upon proper signal from the tower.

For Departing Suburban Trains.—Ten seconds before leaving time conductor will press button nearest to track from which train is about to leave. This will cause the top light to appear in towerman's train indicator board and is an indication to towerman that train is ready to depart on time. No further signaling is necessary to complete the operation for departing suburban trains, which will depart at leaving time.

For Trains Backing Out of Depot.—Before train can be started to back out of depot, the person in charge of movement

² Located at head of terminal yard.

will press button nearest the track on which train is standing. This will cause the top light to appear in towerman's indicator. In no case will the train start to back out until towerman presses button, which will cause the top light to appear in conductor's indicator. Immediately after this top light appears in conductor's signal box, back-up movement will be started.

In the event there are two trains on the same track ready to back out at the same time, the train first entering the trainshed will not move until signal operation of train last arriving has been completed, and train started to back out, at which time train first arriving may follow.

In the event an indication is not received promptly from the tower, the conductor or person in charge of train will go to the nearest telephone and be ready to answer it if the bell rings, and if delay becomes considerable he may call up tower and ask for instructions.

Telautograph and Tower Signal Board.—The telautograph is situated at the extreme left along the wall. The two sending instruments, upon which the levermen write, are on the table. Another small receiving telautograph is on the table directly under the clock. The supplementary flash-light signal board is behind the sending instruments. The complete telephone system with three instruments is at the right.

Baggage, Mail, and Express

All baggage, mail, and express are handled at the street level, the tracks of the terminal being elevated to avoid crossing busy streets at grade. Electric elevators are used in conveying it between the track level and the rooms provided for handling it below.

The station baggage agent is in charge of all matters pertaining to baggage. For the clerical work he has a chief clerk, cashier, and clerks. Counter-check men attend to baggage brought for checking and deliver baggage for checks presented.

The in-room handles baggage brought by trains into the station; the out-room handles baggage brought into

the station to be handled by outgoing trains. There are day and night foremen in charge of each of these rooms with a force of truckers, weighers, checkers, and check-strippers. Baggage is conveyed between in-room and out-room by electric motors in charge of motor-drivers. Baggage is conveyed between baggage room and train platform levels by electric elevator operators.

The United States mail is handled under the supervision of day and night foremen with a force of truckers and clerks. The railroad company carries about fifty men on its station pay roll who are engaged exclusively in this service.

There are four electrically operated belt conveyors, serving eight tracks, the conveyors being located between four "pairs" of tracks. These conveyors extend the whole length of the covered platform so that a mail car can discharge the sacks from any train standing in the terminal. The telautograph advises the operators on the street level of an approaching train and the belt conveyors are in motion when the train stops in the terminal. This plan not only operates as a labor-saving device but reduces the time necessary for a mail car to occupy tracks, all of which are fully utilized during the "rush" periods.

The Chicago & Northwestern Railway mail is also handled under the supervision of day and night foremen with truckers and clerks.

The commissary department for supplying dining and buffet cars is located in the passenger terminal, and such cars are stocked immediately after arrival and before they are moved to the coach yard. This is an unusual arrangement but works well. Supplies taken directly from the ice boxes in the commissary are placed in the ice boxes of the cars within ten or fifteen minutes, shortening the necessary exposure to the elements and unsanitary conditions to the minimum. While

this operation in itself is within the passenger terminal and therefore within the jurisdiction of the terminal superintendent, the commissary department does not report to him nor is it under his jurisdiction in other respects.

Duties of Officers

In the following description of the duties of the various officers it must be remembered that while certain officers report to the superintendent of passenger terminal directly in reference to passenger terminal operation, they report also to their respective departments; that is, the terminal passenger agent reports to the general passenger agent, the chief engineer to the superintendent of motive power, the baggage agent to the general baggage agent, the chief of police to the special agent. Such officers as roadmaster, bridge foreman, and signal supervisor serve for the whole Chicago Terminal District, reporting to the superintendent in charge of any particular terminal operation (freight, passenger, etc.) on matters relating to that particular subdivision of the whole Chicago Terminal District.

The terminal passenger and ticket agent has direct supervision of the ticket sellers and in addition has duties closely allied to those of a general agent of the passenger department.

The station master has supervision of passengers, agents, ushers, gatemen, train-announcers, and matrons, and of the parcel room, information bureau, and emigrants' room.

The passenger agent's duties are to give any information asked for by patrons as to passenger traffic matters, time of trains on connecting lines, rates of fare, etc., and to exercise general supervision over the other employees reporting to the station master.

The chief usher has direct charge of the ushers attending to passengers arriving through the carriage entrances and the "red caps" assisting passengers with hand baggage to and from trains.

The gatemen are charged with getting passengers to the right trains and preventing those not passengers, or accompanying them, from entering the train platform. In addition, as heretofore explained, they participate in the signaling required in starting trains.

The train-announcers call the time of all arriving and departing trains, the latter when the train is ready and just before the time of departure. These announcements are made both on the train level (second floor) and the street level, an announcer being assigned to each floor.

The head matron has supervision over the matrons in charge of the waiting rooms, rest room, immigration room, and hospital. There are a rest room provided with sanitary couches and other conveniences for women, and a separate large apartment for women with young children, for whom cribs and other comforts and amusements are provided. The various rooms with their sanitary toilet and bathroom adjuncts are in each case in charge of a matron. Separate writing room and bathrooms for men are in charge of an attendant. All this service is provided without charge to the road's patrons except the bathrooms.

The parcel room for checking handbaggage and parcels is the usual one with a lost-and-found department attached, to which are taken all articles found in the trains—all of which are searched immediately after the departure of passengers. An average of two hundred articles per week is turned into this department.

There are two information bureaus on the first floor furnishing information as to train time, hotels, parks,

street cars, and other subjects on which patrons need advice, together with public telephone service near by.

All emigrants are taken from and to trains through the emigrant room, which is in charge of men and women attendants day and night. This room is provided with toilets, baths, and all accessories essential to their comfort. The women's room is provided with laundry tubs and steam drying facilities in addition. In order to protect them against theft, imposition, and their own ignorance as to surroundings and conditions, this room is under the supervision of an agent and a matron at all times.

The custodian of the building has charge of the cleaning of the building and driveways and the operation of the passenger elevators. He has a day and a night foreman to assist him. The forces consist of marble, window, general, and driveway cleaners and scrubwomen and elevator operators.

The chief engineer has charge of the power plant of the terminal, which is of very considerable extent. Reporting to him are the chief electrician, in charge of all electrical construction and maintenance, and two engineers (mechanical) in charge of the engine and boiler plants, all of whom have the forces usual in such electrical and mechanical operation.

The station police force is in charge of a chief. The duties are those of patrolling the property, maintaining order, preventing theft and trespassing, and enforcing the regulations as to the operation of the terminals. In addition the chief attends to personal injuries arising from the passenger terminal operation, these latter duties being very light, however, in this particular terminal, owing to the careful supervision on the station platform and at the gates.

A chief clerk with an office force attends to the clerical duties of the superintendent of terminal's office.

The total number of persons carried on this passenger terminal pay roll is about five hundred, which of course includes the station employees only and not trainmen.

In some instances a superintendent of terminal has charge of all terminal facilities, passenger stations, freight stations, yards, team, industrial, and all other tracks. The extent of his jurisdiction will be determined on the basis of volume of business transacted. At such centers as Chicago the nature and volume of the business is such that there must be a minutely divided and specialized supervision of terminal operation to obtain efficiency. At other points, with less volume of traffic, the supervision of all the facilities of a terminal by one officer is entirely feasible from an economic standpoint.

CHAPTER IX

OPERATION—MAINTENANCE

MAINTENANCE OF WAY

This department has charge of the maintenance of the road and structures, including track, bridges, buildings, turntables, water supply, signals, fences, road crossings—in fact all the fixed physical properties used in and in connection with the conduct of transportation.

Each operating division is divided into sections, the work on which is in charge of a section foreman. The length of these sections depends to a large extent on the density of traffic, varying from five to seven miles on single-track roads, from three to five miles on double-tracked roads, and from two to three miles on four-track lines.

The number of switches on the line affects the length of the section and the force to be employed. On an ordinary section about fifteen switches necessitate the employment of an extra man in the gang on track moderately busy; in a terminal or busy yard the number of switches per man of section force is less.

The section gangs are under the immediate supervision of a roadmaster or a supervisor reporting to him. The length of a roadmaster's division varies with the character of the traffic. On the Chicago, Burlington & Quincy Railway it is eighty to one hundred miles of single-track main line with sixty to eighty miles of branch line in addition; on the Atchison, Topeka & Santa Fe Railroad, a total of about one hundred and fifty miles of single track; on the Baltimore & Ohio Railroad, sixty-five to one hundred and thirty miles of single track. On

double-track lines his division varies from forty to sixty-five miles of line; and on four-track lines from twenty-five to fifty-five miles.

The work consists in keeping the roadbed slopes and ditches to the lines of the standard plan of roadbed section; keeping the ballast free of weeds and at proper slope; maintaining the line, surface, and gage of the track, with particular attention to the rail joints; maintaining all switches and fixtures and giving them frequent inspection; replacing old ties and rails with new; repairing permanent fences and placing and removing snow fences; maintaining road crossings; clearing trestles, culverts, and pipes of obstructions; cutting and burning weeds and removing rubbish from the right of way, including ties removed from the track; cleaning and maintaining station grounds; picking up and storing scrap material of value for shipment.

Surfacing is continually required for the track; that is, putting the rails and track in a uniform plane. Surfacing, as here used, refers only to the small raises required to eliminate slight irregularities of the track; once in about four years, as the old ballast under traffic gradually works down into the material of the roadbed and becomes "powdered" under the movement of trains, the entire track is raised "out of face," or brought up to a new surface, which is done with a layer of three or four inches of new ballast.

Track is "lined" after surfacing and then carefully brought to exact "gage" (the standard width between rails) the flanges of engine and car wheels tending to loosen the spikes holding the rails and thus throw them out of line and gage.

Approximately ten to twelve per cent of the ties in the track have to be replaced each year. On moderately busy main lines the rails must be renewed about once in ten years, the rails removed being later relaid on lines

of lighter traffic—as branch lines, and yards. In many situations, as on very sharp curves, under heavy traffic, a rail remains in main-line service for only a few months, the flanges of the wheels cutting the head of the rail to such an extent that it becomes unsafe for operation.

Usually the ties are hauled out by construction trains during the winter, so that they may be available immediately after the frost comes out of the ground, at which time the new ties may be most economically placed, on account of the loosening of the ballast through frost action. On single-track lines the new rail to be laid is strung along the ends of the ties and bolted up so that as the old rail is removed (which is done in “strings” of rail several hundred feet long, moved at one time) the new rail is slipped into place and spiked as rapidly as possible to avoid delaying traffic.

The transportation of ties and rails for renewals necessitates usually the use of a construction or work train, which is in charge of a conductor who reports to the roadmaster. In addition, many roads work what are called “floating gangs,” who live in the boarding cars of the company and are used over the entire division in tie-replacement work in order to have that completed as early as possible after the frost leaves the ground. These gangs also attend to the larger jobs of cleaning ditches and widening narrow places in excavations, caused by winter slides. They are often employed in connection with large rail renewals.

Division Engineer

The division engineer has two masters to the extent that in all matters affecting the standards of track, roadbed, etc., he reports to the chief engineer but in all matters pertaining to the actual work of maintaining the roadbed, track, and structures, he reports directly

to, and works under the supervision of, the division superintendent. He is directly responsible for the condition of the track and maintains supervision over it through the roadmaster, who has direct charge of section foremen and track forces. His work consists chiefly in providing stakes showing the proper center for the track, and other stakes indicating the proper level for the top of the rail; marking on the ground the location of spur tracks or new sidings; and in fact any minor improvement or change in the track arrangement, or the location of buildings and other structures. He has charge of the operation of the ballast forces, the locating and laying out of tracks used in connection with such work, and determining the actual work performed in providing track ballast.

In connection with the superintendent he reports in detail as to the requirements of ties, bridge renewals, road crossings, fences, and all other structures which from their nature require constant replacement. He is required also to inspect and be informed at all times upon the condition of the rails, with the special object of detecting defective rails and other dangerous track conditions.

In cases of wrecks or washouts he may, under the superintendent, have direct charge of all of the track forces employed in that connection. At such times and during periods of long-continued rain or heavy snowfalls, the duties of this officer are most strenuous, as he is charged generally with maintaining the roadbed at all times for operation and of restoring it as quickly as possible when for any reason operation has been temporarily obstructed or suspended.

Reporting to the division engineer are the roadmasters, the foremen of bridges and buildings, and the signal supervisor. Some exceptions to this statement are noted in following pages.

Roadmaster

From the nature of his duties the roadmaster spends most of his time on the line in supervising and instructing the track forces. He usually has from twenty to twenty-five "section gangs" reporting to him. In the laying of important railroad crossings and other special work, he often assumes direct charge. In the annual tie-renewal, which generally takes place in the spring, or at the time of the general clean-up in the fall, he often takes direct charge of the construction train in doing the larger jobs of cleaning cuts and similar work. He receives and passes on the requisitions of the section foremen for the material necessary to maintain the track and other roadbed structures. His principal employment, however, consists of close personal inspection of the track as to line and surface, so that it may be safe for operation, and instructing both generally and specifically the section foremen reporting to him.

Section Gang

This force is in charge of a section foreman and consists of from two to ten men, who maintain from five to seven miles of main line track with the appurtenant sidings and tracks. At certain periods these forces are increased materially for extraordinary work, as during the times of tie-replacement and rail-renewal, and in special work outside the ordinary routine.

Stated generally, this force lines and surfaces track, replaces and tamps ties, cleans ditches, cuts and burns weeds, and repairs fences, road crossings, and other track structures.

The policing of the track is one of the important duties of the section force. Some member of the force

is designated as a "trackwalker," whose duty it is to inspect each rail and joint as he walks over the track, in doing which he tightens all bolts in the joints and notes all low joints and defects at switches for the purpose of reporting to the foreman. It is usual to require the trackwalker to inspect particularly one rail of the track on his trip out over the section, and the opposite rail on his return. In some special situations, as on sharp curves and at certain times where a long-continued rain or snow makes probable the occurrence of slides, special policing of the track is done by the section forces.

Large yards at terminals or at important connections, with the approaches thereto, are often the limits of the section assigned to one foreman, who will be particularly expert in the laying and maintenance of switches and other special track work.

Bridges and Buildings Force

This force consists of a foreman with a force of bridge carpenters, who are charged with the maintenance of bridges, buildings, turntables, track scales, cinder pits, water and fuel stations, fixed signals, mail cranes, and other structures appurtenant to the railroad. On lines whose bridges are built largely of timber, as pile or frame timber structures, this force will be larger than where the bridge structures are of a permanent nature; that is, where steel spans and masonry piers and abutments are employed. In any event the item of replacement of decks on either steel bridges or temporary structures is an important one. The bridge foreman is in addition charged with the duty of frequently examining the foundations of bridges and other structures, particularly where they are subjected to scouring action in riverbeds and like situations. The painting of steel

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bridges and of buildings is in charge of the foreman of this force.

General

There are several variations in the organization of the maintenance-of-way forces necessitated by particularly dense traffic or some special condition. On the Pennsylvania Railroad an assistant engineer has charge of an operating division (equivalent of division engineer), and the supervisors (roadmasters on other roads), who are engineers in training, have charge of about twenty-five miles of double or four-track line each, and report to him. The section foremen have charge of two and one-half to three miles each and report to the supervisors. On each division there is a master carpenter (corresponding to the foreman of bridges and buildings on other roads) and masons for repair work.

On the Michigan Central the superintendent of track reports to the chief engineer, and the roadmaster (who has an assistant) reports to the superintendent of track; carpenters, masons, and painters report to the division foreman of buildings and water stations, and bridge crews to the foreman of bridges; signal inspectors report to the signal engineer.

Signals

The signal supervisors have charge of all station signals, block signal systems, and interlocking plants. They are charged with the operation, maintenance, and inspection of all these signals, being assisted in the field by signalmen and inspectors. On roads having only the simple station signals they report usually to the division engineer; on roads having block signals and interlockers they report either directly to the divi-

sion engineer on operation and maintenance and to the signal engineer on matters of standards, or in most instances to the signal engineer direct.

MAINTENANCE OF EQUIPMENT

The maintenance of all equipment is under the direct supervision of the master mechanic.

Master Mechanic

The master mechanic reports directly to the superintendent of motive power on standards of equipment and to the superintendent on matters pertaining to the mechanical side of operating conditions and maintenance of equipment. He has general supervision over the engineers and firemen in train service, through a road foreman of engines, and general supervision of the engine-house through a foreman of engine-house, and in some instances of shops through a superintendent of shops.

Figure 11, which shows the organization of the Lake Shore & Michigan Southern Railway, is typical of general conditions. The titles of the different foremen and their forces are such as to indicate the nature of the duties of all of them. Hence the diagram itself is presented rather than a description in detail of the various mechanics whose duties are obvious. It is to be noted that the force in the engine-house attends only to the light, current repairs of locomotives, the heavier periodical repairs being performed in the shops designed for that purpose. In the chapter on the Mechanical Department this work is described in detail.

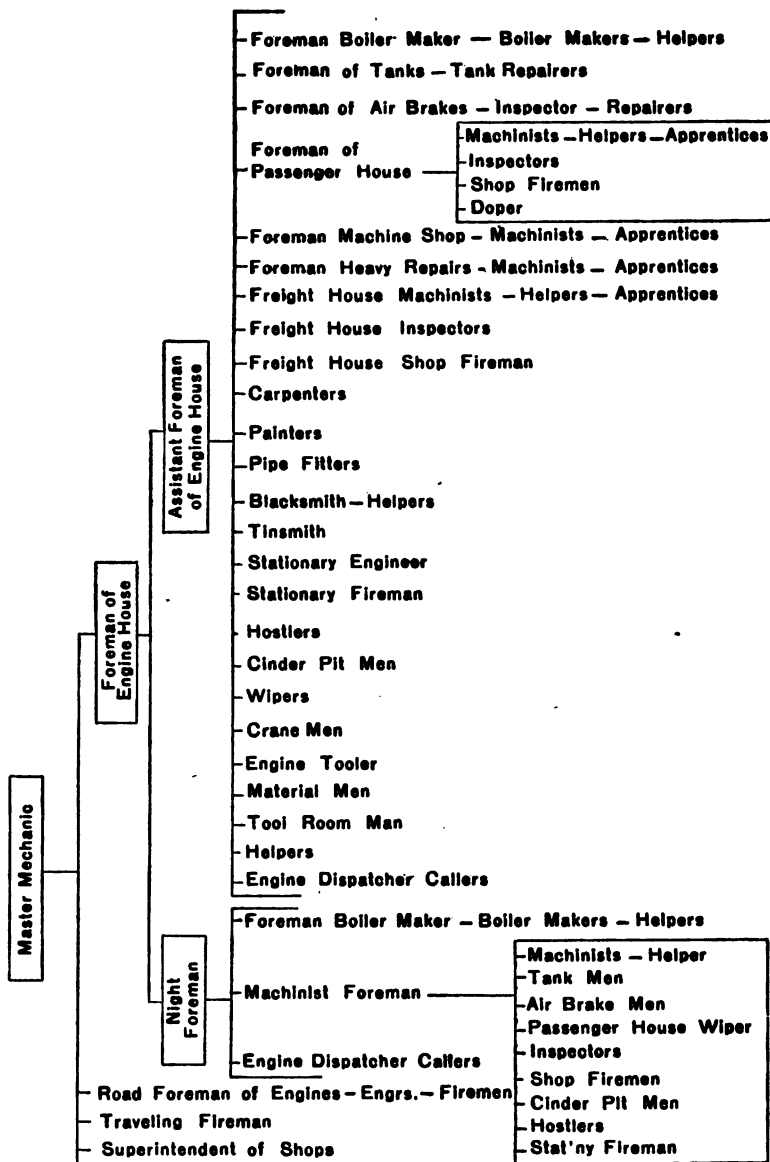


FIG. 11.—Operation—Maintenance of Equipment

CHAPTER X

OPERATION—MECHANICAL DEPARTMENT

This department is charged with the design, operation, and maintenance of all of the equipment—locomotives, cars, wrecking tools, etc.—and the shops, engine-houses, and other facilities required for such purposes. Its work is divided broadly into a motive power department, in charge of locomotives, and a car department, in charge of cars. Each of these subdepartments is further divided as to general duties into design and construction of new equipment and maintenance of all equipment.

The requirements of operation are such that varying equipment is essential to economical operation. Evidently what would be an economical engine under some circumstances would not be under others; hence the necessity for differing classes of engines and cars.

TYPES OF ENGINES

Different types of engines are required for the various classes of service. The switching engines have the simplest arrangement. As such engines have to go around very sharp curves on industrial tracks, the wheel base must be comparatively short, and they have no leading or trailing truck. The former "double-enders," which may be run in either direction, have no leading truck. They are used chiefly in suburban service and have small coal and water capacity.

Engines for freight service may be grouped into three

general classes: those having two-wheeled leading truck with no trailer; four-wheeled leading; and two-wheeled leading and two-wheeled trailer trucks.

In the first group are the "Mogul," used in fast service; the "Consolidation," used in heavy freight service; the "Decapod," used on stiff grades and in pusher service. They have six, eight, and ten driving wheels, respectively. In the second group are the "American," which is the pioneer freight engine; the "Ten-wheeler," well adapted to lines in the Middle West, where a large portion of the traffic is fast freight and stock movement; the "Mastodon," used principally in mountain service. They have four, six, and eight driving wheels, respectively.

The engines in the third group are the same as those in the first, with trailing trucks added. The "Prairie" is a "Mogul" with a trailer added; the "Mikado" is a "Consolidation" with a trailer added; the "Santa Fe" is a "Decapod" with a trailing truck added.

For heavy, fast passenger service on low-grade lines, the "Atlantic" type is used; the "Pacific" type for heavy, fast passenger service on heavier grades. They have four and six driving wheels, respectively.

There are special engines not conforming to the types here shown, such as the huge articulated engines used



FIG. 12.—Types of Locomotives

in pusher or other special service. The types shown above cover practically all standard engines in railroad use with those exceptions.

CLASSIFICATION OF LOCOMOTIVES

Locomotives are classified mainly by their wheel arrangement; their rating is based on tractive power.¹

All railroads have a variety of locomotive equipment, and in order to define distinctly each lot or kind for records, drawings, patterns, and repair parts, the mechanical department makes classifications, using numerals and letters to designate them. There is no uniformity among the railroads as to these classifications, each road having its own system. For instance, the Pennsylvania uses "A" for engines having two pairs of drivers and no trucks; "D" is used for two pairs of drivers and four-wheeled truck; "H" has four pairs of drivers and two-wheeled truck. As there are modifications in detail of engines having the same wheel arrangement, these are indicated by adding a numeral, as "A-1", "A-3." The Rock Island System classifies the engines by numbers, as 1, 2, 3, 4, and shows modifications of class by affixing a letter as "3-A," etc. The "Whyte Classification" gives successively the number of wheels in the truck, drivers, and trailer, as 4-4-2, which is a ten-wheel engine. The American Locomotive Company uses this system and adds the total weight of the engine, as 4-6-0-180, which signifies a ten-wheel engine weighing 180,000 pounds. The "Whyte Classification" is not sufficient for the motive power division purposes, as it simply gives the wheel arrangement and does not indicate the modifications in necessary detail. It is necessary to have a distinctive motive power class designation, such as the "A-1," in order

¹ The theoretical draw-bar pull; i. e., the pulling power of the locomotive expressed in pounds.

to make proper records, compile statistics, and order new or repair parts with certainty.

For the other departments of the railroad, not interested in minor details, another classification is used, showing the type and the tractive power, as "C-25," which indicates that the engine is a "Consolidation" with a tractive power of 25,000 pounds. When the symbols are learned, an idea of the relative size and type is conveyed by the symbol, which is what the operating department wants to know. The equipment books and list show all such details as diameter of wheels, and capacity of tank, if such information is needed in addition. Rating books for each division are kept for the purpose of assigning the proper weight of train for each particular class of engines. In columns headed by classes of engines will be shown the tonnage of train that can be moved on that division by the different classes so that the tonnage rating of train can be assigned from the rating book for any particular engine without calculation. A sample page from such a rating book for the Eastern Division of the Santa Fe Railway is shown in Figure 13.

CAR DESIGN AND CONSTRUCTION

The varying needs of the traffic call for many classifications and modifications in car construction. A standard refrigerator car cannot be loaded with more than twenty-five tons of beef, nor a standard stock car with more than thirty tons of live cattle. Originally it was thought that it would not be economical to build a car of large capacity with its added cost and increased dead weight for the few occasions when it would be used in special service and this maximum loading might be reached, but the use of cars is so developed that it has been found economical to provide sufficient capacity for heavy loading wherever it is practicable.

EASTERN DIVISION											PAGE 3									
TONNAGE DISTRICT	NO. OF CARS	CLASS OF ENGINE																		
		TONS																		
		23	151	283	256	507	468	729	1050											
		41	261	317	542	1400														
EMPORIA TO ARGENTINE	16	800																		
	20	775	1050	1138																
	24	751	1032	1130				1300												
	28	723	1008	1106	1400	1288														
	32	695	984	1082	1376	1264	1600													
	36	665	956	1078	1352	1240	1576	2000												
	40	635	928	1050	1328	1216	1552	1980	2100											
	44		808	1022	1304	1192	1528	1960	2090											
	48		855	994	1278	1168	1500	1936	2085											
	52		825	960	1250	1140	1472	1912	2040											
	56			930	1220	1112	1444	1888	2010											
	60			900	1190	1082	1414	1860	1995											
	64				1158	1050	1384	1832	1965											
	68				1126	1015	1352	1802	1935											
	72						1320	1770	1905											
	76						1094													
	80																			
	84																			
	88																			
85																				

Fig. 13.—Sample Page of Rating Book of the Eastern Division of the Santa Fe Railway

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Two cardinal principles are controlling in car construction: ease of construction, and hence a reduced first cost; ease in making repairs, and hence reduced cost of maintenance. There are many details involved in car construction that require careful work and technical training.

In spite of an experience extending over eighty years, the cars of different roads are not built to the same standards. While they all have cars of the same types, such as refrigerator, stock, and coal, there are infinite variations in the details of their design. In order to facilitate the interchange of cars in through business, there are certain dimensions and shapes that must be the same on all cars. Dimensions for standards for wheel treads and flanges; gaging points for pressing wheels on axles; journal boxes; bearings and bearing keys; contour lines and shanks for automatic couplers; draft attachments, brake beams, etc.—these have been determined by the Master Car Builders' Association, to which all roads of any importance belong. In this way all cars may be coupled to trains with safety and the principal car repairs for any foreign car are available on any road on which the car may require repair. Before the adoption of these standards the car might stand for days or weeks awaiting repair parts from the road which owned it.

MAINTENANCE OF EQUIPMENT

The maintenance of equipment involves three distinct things:

- Preparation of locomotives and cars for service.

- Repair of locomotives and cars.

- Maintenance of the plant required for those purposes.

The preparation of locomotives for service includes the following work at locomotive terminals: coaling, watering, sanding, knocking out fire at ash pit, cleaning the ash pan of the locomotive, moving it into the engine-house at the conclusion of its run, and firing it up and running it to the outgoing track when it is ordered out.

The preparation of passenger cars includes cleaning and furnishing them with water, coal, ice, gas, and other supplies.

The preparation of freight cars includes the lubrication of the journals, and supplying the caboose or way car with coal, water, oil, and waste.

The plant required for maintaining the engines consists of three things: first, the engine-house at the terminal with its appurtenant machine shop, water, fuel, and sanding stations, oil house, etc., which is used for making the light running repairs and for preparing the locomotive for service; second, the intermediate fuel and water stations, and cinder pits between engine terminals; third, the general repair shops for handling heavy locomotive repairs.

For the passenger equipment there are coach yards for preparation for service and light repair work, with facilities for coaling, watering, icing, and supplying with gas at intermediate points, and general repair shops for general repairs, these often being combined with the general engine shops.

For freight-equipment repairs, tracks for light repairs, and a general repair shop.

As to the larger part of the force employed, the supervision is much closer in this than in many other classes of railroad work. Except as to car inspectors and repairers at intermediate points, the forces are concentrated at engine terminal points or in large general shops.

All roads keep very complete records of all costs of maintenance of equipment. In the case of engines, records of each individual engine as well as of different types are kept by different engine-houses, general shops, and divisions.

The objects to be gained in making a close study of costs are to secure greater life for the several parts of engines and cars; to know definitely what sum may be spent in securing such benefit; to detect uneconomical shop operation; to reduce to a minimum the damage from careless or ignorant handling of the equipment.

Kinds of Engine Repairs

The most frequently required of important repairs in engine maintenance apply to boiler, firebox, flues, cylinders, valve seats, and tires. Three sub-divisions of engine repair work are generally used: running repairs, heavy repairs, and general repairs. Engines require the first at the end of each run, the second when they have run from 20,000 to 40,000 miles; the third at the end of 70,000 to 100,000 miles of road service. The light repair work is done at the engine house of the engine terminal, the other repairs at the general shop.

The engineer at the end of his run makes a report of the condition of the engine, and a statement of repairs he considers needed. As many defects are apparent only when the engine is running, this report is important.

The "front-end inspector" will then inspect the spark arresters, while the engine is at the cinder pit. The locomotive inspector makes a careful inspection to form an opinion of the repairs needed, which is compared with the engineer's report. The different mechanics are assigned to specific work, which is afterward inspected. The boiler maker inspects the fire-box before the engines go out for any additional needed repairs.

These repairs are only such as to enable the engine to run without risk of failure to the next shop with its rated train load and on schedule time, when the operation is repeated.

As an engine becomes older, the repairs necessary to accomplish this become heavier. Many parts of the engine are not easily accessible, and the cost of removing and replacing certain worn parts involves handling many other parts which may form a very large portion of the total cost of the repairs. When these running repairs become heavy the engine is given a general overhauling, all parts being repaired that are likely to fail during the next 20,000 to 40,000 miles. This is what is meant by heavy repairs. Of course, the light running repairs will continue during this next 20,000 to 40,000-mile running. The engine will sometimes have two or three heavy repairs before requiring general repairs, which will be required when the total of engine miles reaches from 70,000 to 100,000 miles.

The condition of some parts of the engine cannot be known until it is taken down for general repairs. Suppose some important part appears to have a life of 10,000 miles. The general repairs will place the rest of the engine in service for 20,000 miles. Will it be better to sacrifice the 10,000-mile life of the individual part or tear the engine down again at the end of the 10,000 miles?

The shop room on any road accommodates a fixed number of engines. At certain seasons of the year the demand for power is greater than at others. In order to answer the question given above, the condition of the shop at the end of the 10,000 and 20,000-mile run must be considered, as the engine must go on side track and wait for available shop space if it be fully occupied. If business were such that plenty of engines were available, this would not be a serious matter, but if offered

business could not be moved on account of lack of motive power, it would be serious. The reasons for keeping accurate records of costs and life of the several parts of an engine in different services become apparent when such questions as these are considered, as the net earnings from additional business of an engine in average service might be over \$200 per day. This, too, make it plain that business judgment as well as technical knowledge is required in the solution of many maintenance questions.

Passenger Car Repairs

It is common practice to pass all passenger equipment through the general repair shop at stated intervals, when it is placed in first-class condition, the light running repairs being attended to between such periods at the coach yards. On roads paying particular attention to passenger traffic the cars are overhauled about once a year; on others the periods may be from two to two and one-half years. The factors entering into the cost of such repairs are car mileage and the proportion of the several kinds of passenger equipment, as baggage, day coach, chair, dining, etc. It evidently requires less expenditure to keep baggage and mail cars in serviceable condition than the highly finished upholstered coaches.

Freight Car Repairs

The factors entering into this cost are car mileage, the proportion of cars of different capacities and classes (refrigerator, flat cars, etc.), and the manner of handling cars in yards and in train service.

The repairs are seldom anticipated and are limited to replacing broken or decayed parts when the condition of the car demands it. The larger part of damage

to cars is caused by rough handling in switching service in yards. The remedy for repairs due to this cause is the special inspection of such service in large yards.

Engine Terminals

Engine terminals are in charge of the master mechanic, or if small, of an engine-house foreman reporting to him. The master mechanic has general supervision of the entire engine work of the terminal; the assignment of engines; and the supervision of supplies in the store room to avoid delay on account of needed parts, or carrying larger stocks of parts than are required. His principal duty is being thoroughly informed of the condition of all engines running into his terminal, so that he may judge the proper time for making general or heavy repairs. He gives special attention to the cause of the breakage of parts with a view to eliminating as many of them as possible.

The engine-house foreman has direct charge of the mechanics, boiler makers, hostlers, coalers, cinder-pit men, wipers, callers, fire-up men, and all the other labor having to do with the preparation of and the making of the light repairs to the engines.

These engine terminals on a system will, as an average, be located according to train districts at intervals of 125 to 150 miles along the main lines, with intermediate engine-houses for connecting branches.

General Repair Shop

This shop is located with reference to the convenience of service to the entire line, and to the engine terminals just mentioned, which it must supply with repair or new parts. The general repair shop is made up of a number of subshops, as: tool, erecting, machine,

blacksmith, boiler, tin, copper, and pipe shops, foundry, planing mill, paint shop, lumber yard, car shop, upholstering shop, miscellaneous shop, stores department.

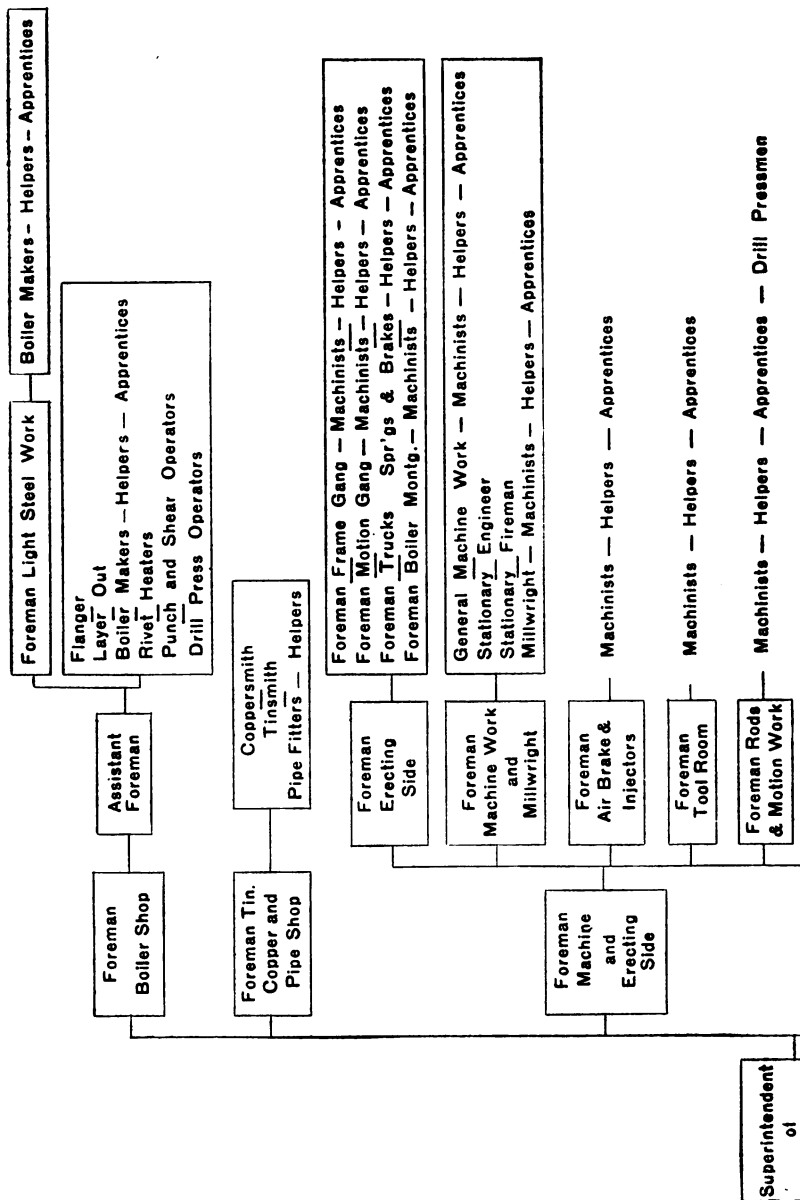
Figure 14, showing the organization of a shop on the New York Central (Lines West) indicates the general work done.

These various shops are so equipped that the capacity of one is arranged for the capacity of the others and the capacity of the machines is arranged for the capacities of other machines. These shops are manufacturers of tools and various repair parts for other than engine and car repairs.

Most large railroads are an aggregation of smaller roads built under separate standards, and in addition there have been most radical changes in size of engines and cars in the last few years. As a result the equipment and tools comprise a heterogeneous mass, making the interchange of parts practically impossible as to most of it. The shop operation, therefore, consists of the manufacture of a multiplicity of parts and tools. Most large systems standardize their locomotives into eight or ten sizes, and five or six types, but much of the old equipment remains on branch and unimportant lines for years.

OFFICERS

The officer at the head of the mechanical department is called superintendent of motive power, or some similar title. He has supervision of all matters pertaining to the construction and maintenance of locomotives, cars, and machinery, and issues instructions covering standard designs and methods for the guidance of the maintenance-of-equipment department. He keeps a record in detail of all the locomotives, cars, and machinery of the company, and all standard drawings



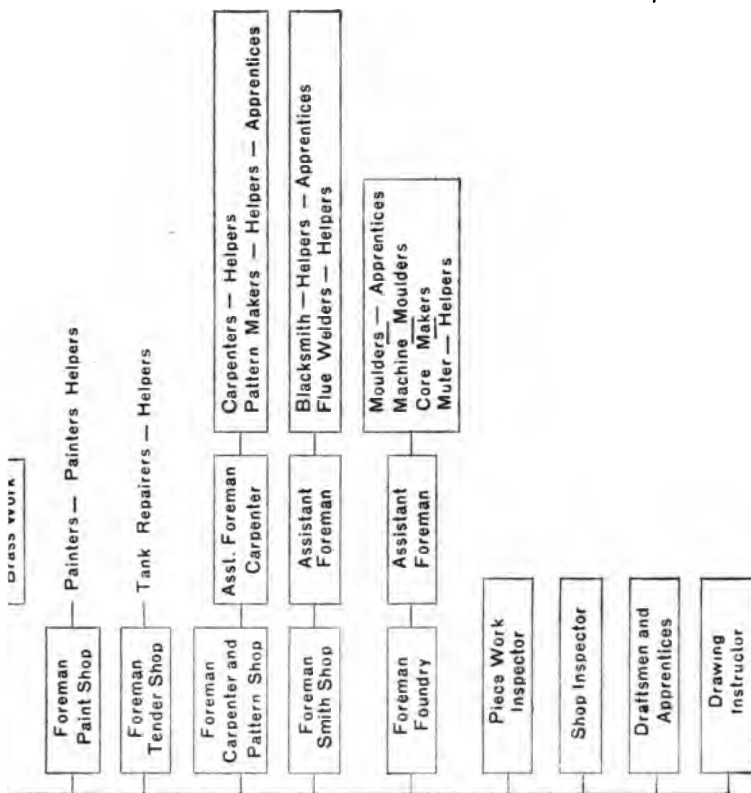


FIG. 14.—Shop Organization of the Lake Shore & Michigan Southern Railway

relating to the department, and examines and approves all plans for shops, engine-houses, and coaling stations. He is responsible for proper charges against foreign lines for repairs made to their equipment. He appoints mechanical superintendents, mechanical and electrical engineers, inspector of shops, and general road foreman of equipment.

The inspector of shops inspects the maintenance of equipment and the organization and methods employed.

The general road foreman is charged with knowing the qualification of the various road-foremen; the enforcement of the rules applying to enginemen; instruction of road foremen in standard practices and methods; economical use of fuel, lubricants, and other engine supplies; seeing that engines actually haul their rated tonnage; seeing that all reports required of enginemen are properly made: personal inspection over the road on engines; assisting in the investigation of motive-power or transportation cases where enginemen are concerned.

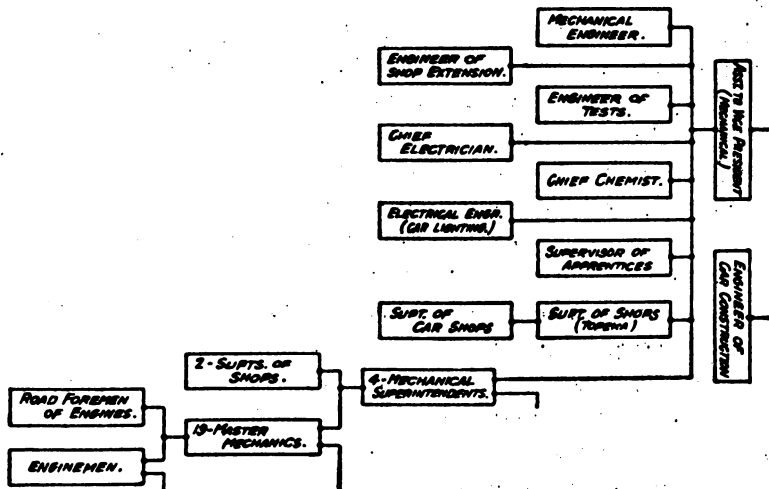


FIG. 15.—Organization of the Mechanical Department of the Atchison, Topeka & Santa Fe System

The mechanical superintendent has direct charge of the general repair shops and of the construction and repair work; keeps records of cost of labor and amount of material used; and is generally responsible for the economical management of the shop. He advises the superintendent of motive power in cases when equipment requires general repairs or reconstruction in the immediate future.

Figure 15 shows the organization of the Mechanical Department of the Atchison, Topeka & Santa Fe System.

The head of the mechanical department is an assistant vice president reporting to the operating vice president. *The engineer of car construction* is responsible for car design and standards and reports also to the operating vice president.

There are thirteen officers on the staff of the mechanical assistant vice president.

The mechanical engineer is responsible for the design and standards of motive power (locomotives) and shop standards.

The increase in the size and the amount of equipment required on a system whose volume of traffic continues to grow, demands constant additions and extension of shop facilities. Such extensions and betterments are under the supervision of the *engineer of shop extension*.

The engineer of tests conducts tests of locomotives and of various materials required in their construction and other material used by the mechanical and other departments. The chief chemist conducts various tests and investigations as to the chemical constituents of various materials used by the railroad. The character of the work performed by these officers is described in detail in the paper on tests, which will be found in the chapter on Miscellaneous Departments.

There is a *chief electrician* in charge of electrical

work and standards and an electrical engineer in charge of car lighting.

In the various shops of the mechanical department, young men seventeen or eighteen years of age are apprenticed to the company until they become of age, for the purpose of training them in the various trades in which the shop force is engaged. These apprentices are under the supervision of the *supervisor of apprentices*, who reports to the assistant vice president.

The largest locomotive and car shops on the system are located at Topeka, Kan., and are under the supervision of the *superintendent of shops*, who reports direct to the head of the department.

The four mechanical superintendents represent the mechanical vice president in the major or grand-division organizations. Their duties and those of the officers reporting to them have been previously described.

REPORTS AND STATISTICS

The operation of the mechanical department is much the same as that of a large manufacturing establishment and to a greater extent than any other department of a railroad is susceptible to statistical control. There are a great many details in the maintenance of equipment which can be standardized by statistical records so that any deviation from the normal stands out plainly. The officers of the department through detailed reports are able with great exactness to determine the most efficient type of locomotive or cars for a given service or the kind of wheel, spring, or fire box which serves best in any particular situation. The number of reports and records made by various members of the department is large in the aggregate, the following being a statement of some of the more important ones:

Efficiency of enginemen and firemen report made by road foreman to master mechanic.

Enginemen's performance sheet, showing miles run, locomotive failures, overtime, lubricants used, tools used, coal consumed, with enginemen's saving or loss of fuel as compared with the average.

Individual locomotive record, kept by the superintendent of motive power for each locomotive, showing the continuous record of costs, mileages, etc.; mileage made in the period between classified repairs and monthly mileage; cost of classified repairs of locomotives; locomotive running—repair statement. This shows monthly mileage, running repair cost, general condition, locomotive failures.

Dispatchment report, showing number of engine assignments and cost of operation of engine-houses.

Monthly report by the master mechanic on locomotive boilers tested and washed and stay bolts examined. Summary of repairs to passenger and freight equipment and classified repairs to passenger equipment. Report on wheels removed, guaranteed springs changed, and tires turned. Statement in regard to tools and machinery at various shops.

The master mechanic makes a monthly shop operation report, which is a general analysis of the expenses for the month.

When for some special purpose it is desired to keep separate the cost of any piece of work, shop orders are used. The labor cost is kept separate for each one of the shops it passes through, and the material separated according to material accounts.

Statements are kept showing oil and waste furnished trainmen and enginemen, tools used, journal bearings used, received and on hand, lumber received and appropriated, and material for freight car repairs.

The engine-house and road foremen report to the master mechanic monthly the conditions of locomotives as determined by actual inspection.

Enginemen report daily to engine-house foreman the repairs required on locomotives used.

Fuel costs the railroad more than any other single item of expenditure. The system of coal accounting is carried out in great detail.

A card way-bill accompanies each coal car from shipping point to destination, being handled by the conductor as way-bills are and left at destination with the agent who delivers them to the employee in charge of unloading the coal. On the back of the card way-bill is a form giving all details of the shipment, which is filled out by such employee and forwarded to the master mechanic.

The superintendent makes a daily telegraphic report to the superintendent of motive power of the fuel situation, which gives:

Cars loaded at mines.

On hand at coaling stations and yards.

Delivered to connecting divisions.

Consumed on division.

The fuel foremen report to the superintendent daily the coal unloaded and delivered at each coaling station.

Tickets taken at coal company tipples are sent to the master mechanic daily. The master mechanic keeps a record of coal received and used at each coaling station separately.

The superintendent of motive power at the end of each month charges each division or department with coal used by it.

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Coal-ticket books are issued to enginemen, who give them properly indorsed to employees in charge of coal-ing station. This is done to keep individual record of coal used by each engineman and as check on total used.

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CHAPTER XI

OPERATION—TYPES OF ORGANIZATION

DEPARTMENTAL ORGANIZATION

The general idea is that the division superintendent cannot at the same time do three things well—conduct transportation, supervise the overhauling of an engine, and keep up a good track; that it takes a different kind of talent and training for each of these three important things, and a man ordinarily is not at the same time a civil engineer, a mechanical engineer, and informed on the assembling and moving of trains; that the division of authority should be made on the basis of the *character* of the work to be performed in operation, and as there are three separate functions—transportation, maintenance of way, and maintenance of equipment—there should be three separate kinds of officials to attend to them.

This is much the same proposition as that a man goes to an oculist for eye treatment, to a nerve specialist for nervous diseases, and to an aurist for ear trouble, rather than to the family doctor who knows something about them all.

The departmental advocate proposes to get the best civil engineer and the best mechanical engineer and bring their training to bear upon the smallest details of operation in the division organization.

In the departmental form there is very little division of authority; the division engineer reports to the engineering department in all matters, the master

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mechanic to the mechanical department in all matters; while in the divisional organization they report both to the division superintendent and to their own departments. As a general principle, division of authority is not good, particularly in the matter of discipline, as there may not be thorough supervision of a particular officer or employee if he has two "bosses."

This is more often the argument of technically trained men than of men not especially trained. The civil and mechanical engineers are the fathers of the railroad, but their habits of mind are not those usual in the executive trained in the operating school.

During the period immediately following reconstruction, the track and equipment being new and requiring less maintenance than at any other time, conducting transportation is the most important single item of the three separate functions of the operating department. This explains in large part why the transportation official has very generally been placed in charge of the operating department rather than the specially trained engineering officials.

As the general manager has usually come up through the transportation department, he is likely to give the transportation man in the divisional unit charge over his brothers, and it has come about from this circumstance that the general form of organization is the divisional form with the transportation officer—division superintendent—in charge.

DIVISIONAL ORGANIZATION

The idea of this form of organization is to divide the responsibility of operation on a territorial basis, rather than on the character of the work; to place authority over all the employees on a division in one official, delegating to him as much responsibility as

possible, in order that some official "on the ground" may have authority and the necessary forces to act promptly, particularly in emergencies, avoiding the delay which reference of such matters to the heads of departments involves in the departmental organization.

As to the objection that in this form of organization certain employees and minor officials must report to more than one officer, it is urged that it is not practicable to have a strictly departmental organization in any event. The enginemen evidently must report both to the transportation and mechanical departments, the station agents to practically all departments, etc.

In placing responsibility for derailments, wrecks, and other accidents, the cause must be definitely determined; that is, whether it occurred through a defect in track, defective equipment, or a disregard of the rules for conducting transportation. The division superintendent, being in charge of the three departments, is supposed to be able to determine this, being free from departmental bias.

When operation of the road is threatened or actually suspended by washouts, land slides, or wrecks, the division superintendent can gather all the forces on the division—transportation men, road men, shop men, and mechanics—in the shortest space of time, as they are directly under his authority and accustomed to taking orders from him.

DEPARTMENTAL VERSUS DIVISIONAL

One particular objection urged against the departmental form is the jealousy between departments, and there is no question that it is natural and does exist among men specially trained along different lines. On the other hand there is just as certainly jealousy between

divisions, each striving for superiority in efficiency—which the statistics indicate. This, however, is not an unmixed evil; on the contrary, it is a positive advantage if not carried too far. The answer to both objections is that the supervision from above should restrict the jealousy and competition between departments and between divisions within reasonable limits.

In case of accidents requiring the prompt assembling of large forces of men under one responsible head, it is provided in all departmental organization that all forces on the division are to be available to the officer charged with maintaining the operation, whether he be the engineer or the superintendent.

The strongest point in favor of the divisional organization when carried to the extreme is the large measure of authority vested in a division superintendent who can when occasion demands act promptly and report to his general superintendent or general manager afterwards. Supervision from a distance, however well trained and wise, cannot in many situations take the place of the intimate knowledge and close contact with conditions of a local officer. Such supervision involves time, and time is often the essence of the problem needing solution.

On short roads or small systems of, say, five hundred or six hundred miles, a departmental organization is generally used, as the general superintendent in such cases has an intimate knowledge of general conditions and close contact with the heads of the engineering and mechanical departments.

Above the divisional unit the organization is largely departmental on many railroads, particularly the headquarters organization.

An attempt at a more scientific arrangement has been made in what is termed the unit system of organization, which has been tried experimentally on the Harriman Lines at the suggestion of Major Charles Hines, a staff

officer of those lines charged with the investigation of railroad organization.

DESIGN VERSUS EXECUTION

There are two elements in all work—the plan or method, and the executive policy.

For instance, on a road constructed at the lowest possible original cost in an undeveloped territory, the traffic density increases as the railroad develops its resources. When the traffic reaches a sufficiently large volume, the question of reducing grades, revising the alignment, and reconstructing the road in large part to effect economies in the cost of operation will come up for solution. The method and designs (plans, maps, etc.) for reducing the grades and revising the line, together with the cost, will be worked out by the construction division of the engineering department; the time for making the improvement will be decided by the executive head of the railroad and the board of directors. Or it may be more economical, if the permanent way is strong enough, to defer the very heavy expenditures which such radical improvements involve and increase the traffic-carrying capacity of the road by using larger locomotives, thereby making it possible to increase the length of the train which may be moved by one engine. If the heavier locomotives are to be constructed, the head of the mechanical department—superintendent of motive power or whatever his title may be—will design an engine meeting the operating conditions; the executive will decide in this case when such operation shall be undertaken.

The chief engineer of maintenance of way will design the cross section of the roadbed and track section and the track forces will in all cases maintain the work in accordance with his plans, but the actual work is under

the supervision of the officer charged with track maintenance.

One class of officers determines how work is to be done, and another class does it; the one class is charged with standards, the other with the execution of work in accordance with such standards. The officers responsible for such standards are the representatives (usually the heads) of their departments advising the chief operating officer, and are sometimes called staff officers as distinguished from those officers charged with the execution of the work who are called line officers.

On the Pennsylvania Railroad there are a chief of motive power, responsible for standards, reporting directly to the vice president in charge of the mechanical department, and a general superintendent of motive power, reporting to the general manager. The first is a staff officer responsible for standards, and the second a line officer responsible for the actual operation of the mechanical department.

The work of these staff officers in connection with design has been taken up in previous chapters entitled "Engineering" and "Mechanical Department." They have been referred to in this section in so far as they are concerned with actual operation.

REPORTS AND STATISTICAL CONTROL

Comparing the operations of a railroad system with those of a manufacturer, we find that the engineers build the plant, the operating department manufactures the transportation, and the traffic department sells it. There is, however, one marked difference between the operations of an ordinary manufacturer and those of a railroad company. The former from the nature of his plant may give all his operations close detailed supervision; the operations of a railroad extend over very wide areas,

and the supervision over all its employees must be very much more general.

Contrary to general belief, much of the greater part of the business of a railroad company is competitive, not only as to the through business with other railroad companies, but as to a large part of the producers on its line as against the producers on other lines. The general impression that all so-called local business is non-competitive is not correct, for much of the business done is based on competition in a common market. While the business actually done is local to the line performing the service, it comes into competition with similar business on other lines coming into the same market.¹ For these reasons the margin of profit in the transportation is small, and supervision must be exercised to the greatest possible extent which circumstances will allow.

The authority of a general manager must be exercised through many assisting hands. For this reason the whole property is divided into operating units, the operating results on one being compared with those of the others and operations for a given period being compared with the corresponding preceding period, as previous day, same month in previous year, or a previous year entire. In making comparisons it is necessary to have standards of measurement and therefore to establish various units.

The leading American units are ton mile, passenger mile, and train mile; average trainload (tons and passengers); average carload (tons); average length of haul; average receipts per ton mile and passenger mile; average density of traffic; and operating ratio, the percentage of the total receipts which is paid out for operating expenses.

¹ How strongly competition affects transportation is clearly shown in the treatises on freight rates which are a part of this course.

All the information for obtaining these units is derived from the way-bills and ticket sales by the accounting department. The results obtained by the accounting department as to the monthly statement are not available, however, until after the middle of the following month. It is necessary to have a daily means of checking operations, and the train sheets afford such means. These sheets show every train moved, the number of cars empty and loaded, the number of passengers, and whether or not the schedule has been maintained. The daily train sheets go to the division superintendent, and to the general superintendent as well. The monthly reports from the auditing department go to these officials and in addition to the general manager, president, and board of directors.

The superintendent receives daily reports showing (1) the number of through trains of loaded cars; (2) number of through trains of empty cars; (3) all trains, freight and passenger, with number of cars and tonnage, together with delays and their causes; (4) condition of all yards on his line; (5) through cars received and forwarded at each terminal and important intermediate junctions; (6) cars on hand and number of cars required.

He keeps a tabulated statement of these statistics for comparison with the same day and month of the previous year. That is, his standard of measure is previous performance rather than the absolute figures themselves.

The reports for the general superintendent vary somewhat with the character of the traffic of his line. He usually receives, however, daily reports covering the following general subjects: (1) delays to passenger trains; (2) freight cars handled and switch engines in service; (3) general condition in every large traffic center as to wheat, cotton, coal, oil, and other commodities; (4) general condition in the whole district as to one or more commodities which are of importance to his line;

(5) engine conditions at each terminal and at other important points; (6) number of cars of company material unloaded, and of cars ready for loading for each division; (7) through freight engines by divisions, showing mileage made daily; total number of through freight engines on the train sheet; number out of shop and available for service; number coming out of the shop within the next twenty-four hours; number in shop not coming out; total mileage made by through freight engines, with the average of all; special engine assignments classified as way freight, pick-ups, passengers, switch, etc. He also receives the following car reports: (1) cars moved by divisions; (2) cars short by divisions; (3) conditions of yards as to space available for cars; (4) total number of cars on storage at 5 A. M.; (5) merchandise cars on hand; (6) merchandise cars unloaded previous day; (7) number of cars of the several classes of freight exchanged, with the important connecting lines; (8) detailed condition of special commodities at important points, loaded cars moved, and condition of yards; (9) car supply with particular reference to such commodities as grain, coal, and live stock.

The absolute figures of these reports have little value for an officer not familiar with the previous operation of the road. His measure of efficiency, like that of the division superintendent, is largely previous performance and the comparison of the operation of one division with other divisions similarly situated.

It is physically impossible for the general manager of a railroad system to examine all the detailed reports just mentioned. They must be condensed and a general statement of conditions presented to him, as his supervision can only be very general. He usually receives daily reports about as follows: (1) trains and cars moved over several principal divisions; (2) passenger-train delays; (3) position of fast important through trains

both regular and special; (4) total number of cars handled and switch engines in service; (5) detailed car movement with regard to the most important traffic centers and special commodities; (6) report of weather conditions on the various divisions; (7) car detentions.

He receives monthly reports from the accounting department on the expenditures for maintenance of roadway, and separately on equipment, the statement being compared with previous periods. These comparative statements explain in detail all large increases and decreases in amount of traffic. He receives figures of a similar nature in reference to the conducting of transportation; a statement of bad-order cars compared with previous period; a statement of empty-car mileage as compared with total car movement. He also receives a statement of each important station showing traffic received and forwarded by cars and by tons, station expenses, yard expenses, and number of cars interchanged with connecting roads.

The monthly reports from the accounting department divide operating expense in much detail, as it is very important to know the cost of the many separate operations which go to make up the total in order to exercise close supervision over it.

The general manager compares such figures with records of previous performance on his own road, and, where available, with records of operations of other roads similarly situated. It is apparent that the chief reliance of the head of the operating department in exercising his general supervision is an accurate statistical record.

Statistical records are of little practical use unless they are kept in such a manner that they may be used to determine proper action in the future; otherwise the interest in them is purely academic. For instance, an engine has a certain tonnage rating; does it in operation

20. What is the relationship of general counsel to the company?
 21. When a railroad company is unable to buy equipment outright how is the purchase consummated?
 22. Through what department do the carriers sometimes ratify traffic agreements?
 23. What are the functions of district or state solicitors?
 24. What are the divisions of the work of the engineering department?
 25. How is the work for construction purposes divided?
 26. What are residencies?
 27. For what purpose is excavated material observed?
 28. What are the duties of the office engineer?
 29. For what purpose is the reconstruction of a railroad undertaken?
 30. What advantage is obtained through reduction of grades?
 31. What necessitates track elevation?
 32. For what reasons are additional main line tracks constructed?
 33. What was the cost of constructing the Pennsylvania Terminal at New York?
 34. What led to the construction of the yards at Clearing,
- III.
35. What are the duties of the engineer of construction?
 36. What duties devolve upon the locating engineer?
 37. To whom do the resident engineers report?
 38. What two classes of work are involved in bridge construction?
 39. What necessitates extraordinary inspection of material entering into the construction of bridges?
 40. What is the distinction between classification yards and storage yards?
 41. Were all roads originally constructed on the same standard?
 42. Why is sand the best material to be employed in track elevation?
 43. On the New York Central Line what is the title of the officer in charge of track elevation?
 44. What are the duties of district engineers?
 45. The engineer of maintenance of way may be known by what titles?
 46. With what feature is the engineer of water supply concerned?
 47. What advantage is obtained by the establishment of timber-treating plants?

a large percentage of such traffic, if certain units of comparison are used, as ton-mile cost. As a matter of fact, it is possible for a road to make more net money with a high operating ratio than with a lower one.

The comparison with other divisions of the same road, or with divisions of foreign roads on the basis of ton mile or train mile alone means little. One division may have grades of 16 feet to the mile, the other grades of 70 feet to the mile. With engines of the same tractive power, the same traffic can be moved in two trains on the low grade line that would require five trains on the other.

When grades are the same and the engines used are of a different class, a fair comparison can be made on the basis of gross ton and traction ton miles. The gross ton mile is the weight of car and lading multiplied by the distance moved; the traction ton mile is the product of the weight on locomotive drivers and miles moved. The gross ton mile is the measure of work; the traction ton mile is the measure of force performing it. If the gross ton mile per traction ton mile can be increased, the efficiency is increased; if it can be done at less cost there is greater economy.

The cost of maintenance varies widely with the characteristics of the territory traversed. It will evidently be larger for a roadbed built across a swamp than in a rolling prairie country, well drained.

The cost per ton mile on perishable freight will evidently be higher than on coal; the one requires fast service, and fast service means a decrease in the train load. On lines hauling high-grade merchandise the lading per car will be less than on such commodities as coal, lumber, or grain. In the one case the haul may involve 5 tons of lading hauled 1,000 miles, the net ton mileage being 5,000 tons per car; a coal car carrying 50 tons hauled 100 miles would have the same net ton

mileage, but evidently the cost of transportation would be very much less.

Comparison with previous performance on the same division or on divisions similarly located is valuable. For instance: if the average tonnage per train is increased on the division over that of a previous period, evidently the operation is more economical.

Comparisons are always misleading when the physical characters of the lines vary, when the commodities hauled are unlike, and when they demand different classes of service, as perishable freight and coal.

EXAMPLES OF OPERATING ORGANIZATION

Atchison, Topeka & Santa Fe Railway

The vice president in charge of operation and construction is at the head of the operating department. His staff consists of twelve officers, as shown in Figure 16, whose duties are as follows:

The head of the mechanical department is an assistant to vice president. He has charge of all mechanical matters, that is the designing of locomotives and the maintenance of all the equipment of the company. The mechanical organization is described in detail in the chapter on the Mechanical Department and will not be repeated here.

The engineer of car construction reports direct to the vice president of operation and is a staff officer, responsible for the designs and standards of car construction.

The superintendent of transportation is charged with the distribution of both passenger and freight cars between system lines, including Pullman cars. Through four car accountants he keeps track of company cars on foreign lines and foreign cars on company lines, as well as the distribution of cars between system lines.

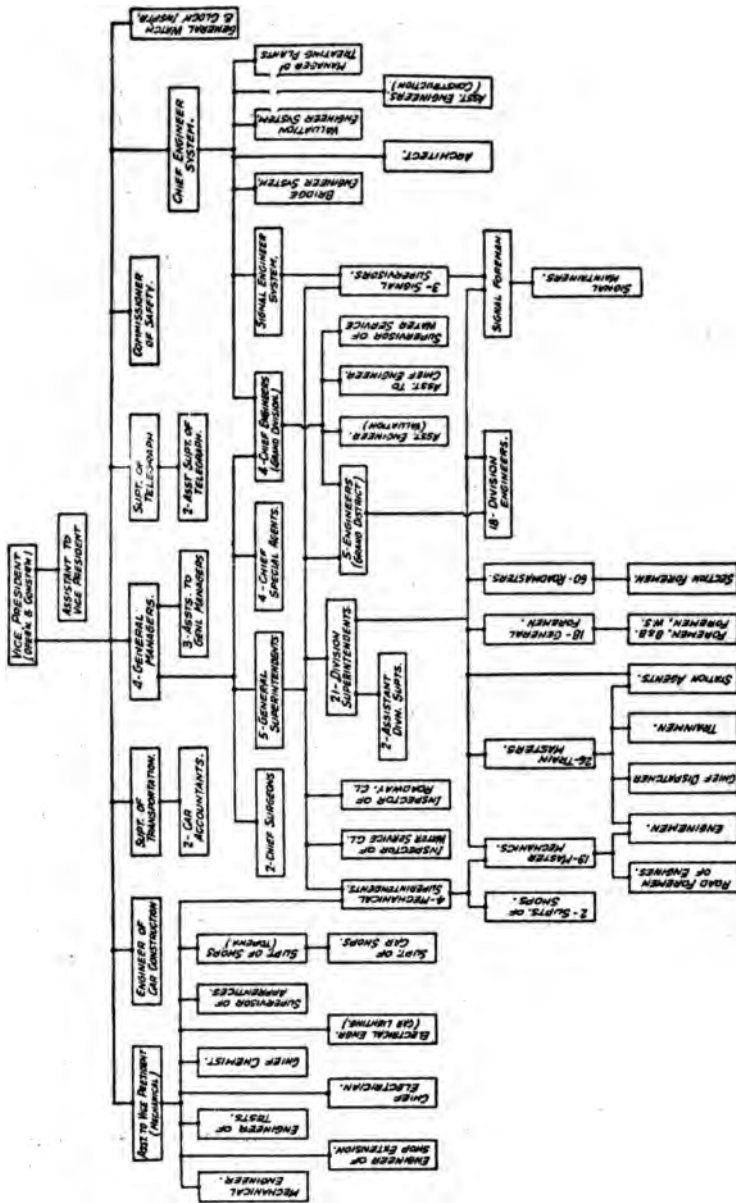


FIG. 16.—Operating Department, Showing Vice-President at the Head of the Operating Department and His Staff of Twelve Officers

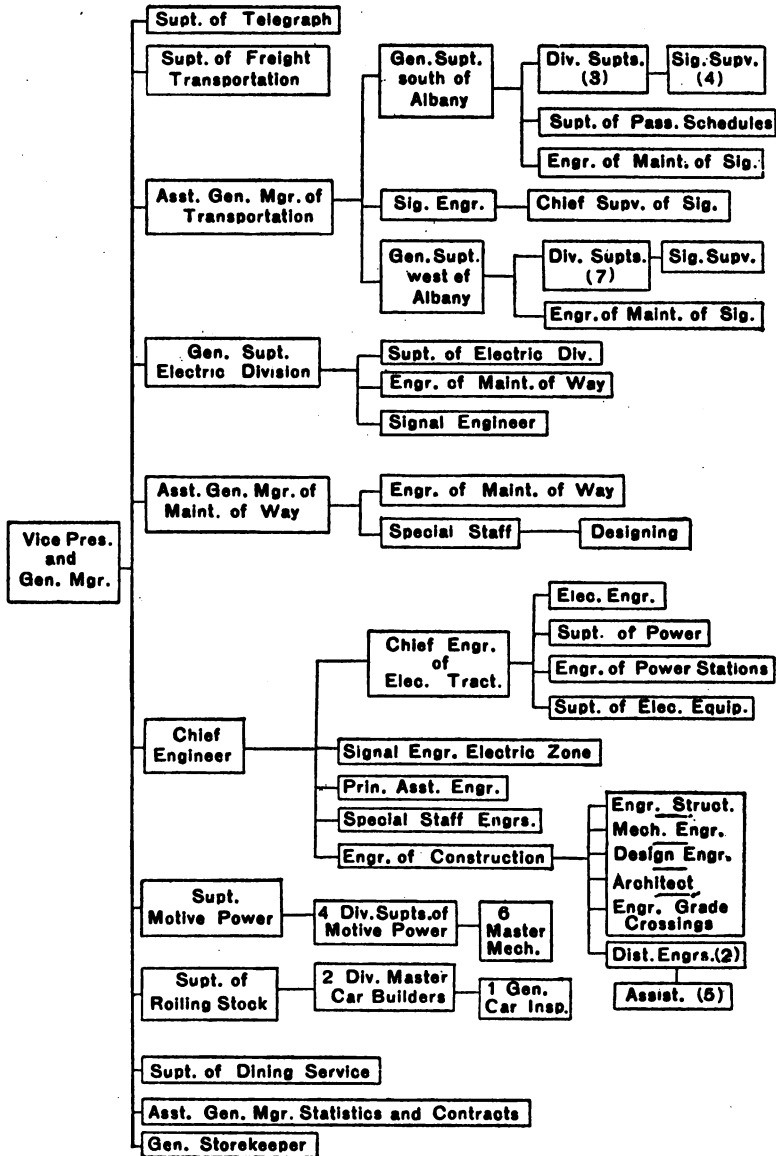


FIG. 17.—Operating Department of the New York Central Lines—East of Buffalo

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The superintendent of telegraph with two assistants has charge of all telegraph and telephone lines and communication on the system.

The commissioner of safety attends to all matters relating to the "safety-first movements" in the education of employees and the traveling public and secures data for the purpose of making such rules and regulations as to operation as will tend to decrease the injury to persons and the loss of property. He travels over the system lecturing to employees and showing the practical application of his advice with the aid of moving pictures and other devices. The general watch and clock inspector's duties are obvious.

The chief engineer of the system (and therefore the head of the engineering department) reports to the vice president of operation. His organization has been described in the chapter on Engineering.

There are four general managers, each with an independent organization of transportation, engineering, and mechanical officers. The usual medical and police officers are included in the organization.

There are five general superintendents and four chief engineers reporting to the four general managers. There are five district engineers, four mechanical superintendents, and twenty-one division superintendents reporting to the five general superintendents. That is, there are four constituent general manager's organizations, similarly constituted within the operating department of the system.

New York Central Railroad

Figure 17 shows the operating organization of the New York Central Lines East of Buffalo. It is interesting by way of contrast to the Atchison, Topeka & Santa Fe organization, the one being strictly departmental and the other divisional.

The organizations of the general superintendent of the electric division and that of the chief engineer are interesting as showing the character of organization required for operation with the electrified zones of steam railroads.

TEST QUESTIONS

These questions are for the student to use in testing his knowledge of the assignment. The answers are not to be sent to the University.

1. On what is the successful manufacture of goods contingent?
2. What are the two chief elements in any undertaking?
3. Does the business of transportation differ materially from other commercial or manufacturing enterprises?
4. What department is in touch with the investing public?
5. In what way does the public come in contact with the operating department?
6. To what department of a manufacturing enterprise does the traffic department of a railroad correspond?
7. What are the divisions of the financial department?
8. What department determines the standards of equipment?
9. In what divisions may the representatives of a corporation be assigned?
10. What functions are performed by the stockholders?
11. Are the directors of the company subject to the dictates of the stockholders?
12. What is the average amount held by each holder of railroad securities?
13. How is the chairman of the board of directors selected?
14. On what qualifications were the presidents of the earlier railroads selected?
15. How does the executive department of the Nashville, Chattanooga & St. Louis Railway differ from that of the Norfolk & Western Railway?
16. In the Harriman Line organization what were the functions of the director of maintenance and operation?
17. By whom are stock certificates signed?
18. Who attends to the registration of stock?
19. Who is custodian of the funds secured from operation?

20. What is the relationship of general counsel to the company?
21. When a railroad company is unable to buy equipment outright how is the purchase consummated?
22. Through what department do the carriers sometimes ratify traffic agreements?
23. What are the functions of district or state solicitors?
24. What are the divisions of the work of the engineering department?
25. How is the work for construction purposes divided?
26. What are residencies?
27. For what purpose is excavated material observed?
28. What are the duties of the office engineer?
29. For what purpose is the reconstruction of a railroad undertaken?
30. What advantage is obtained through reduction of grades?
31. What necessitates track elevation?
32. For what reasons are additional main line tracks constructed?
33. What was the cost of constructing the Pennsylvania Terminal at New York?
34. What led to the construction of the yards at Clearing, Ill.
35. What are the duties of the engineer of construction?
36. What duties devolve upon the locating engineer?
37. To whom do the resident engineers report?
38. What two classes of work are involved in bridge construction?
39. What necessitates extraordinary inspection of material entering into the construction of bridges?
40. What is the distinction between classification yards and storage yards?
41. Were all roads originally constructed on the same standard?
42. Why is sand the best material to be employed in track elevation?
43. On the New York Central Line what is the title of the officer in charge of track elevation?
44. What are the duties of district engineers?
45. The engineer of maintenance of way may be known by what titles?
46. With what feature is the engineer of water supply concerned?
47. What advantage is obtained by the establishment of timber-treating plants?

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48. What was one of the first electrified zones?
49. What has led to the establishment of the electrified zones elsewhere?
50. What is the length of the electrified zone on the Chicago, Milwaukee & Puget Sound?
51. What voltage is received at substations of this line?
52. What voltage is delivered direct to locomotives?
53. What is the tractive power of the Mallet steam locomotive as compared with the electric locomotive?
54. What is meant by regenerative braking?
55. On the New York Central are overhead conductors employed as well as a third rail?
56. What is the objection to the adoption of electrification as a motive power generally?
57. How does the engineering organization of the Louisville & Nashville differ from that of the Atchison, Topeka & Santa Fe?
58. For the purpose of operation how is a road divided?
59. What may be said to be the average length of divisions?
60. To whom do the section forces report?
61. Eliminating density of traffic, what mileage may be handled efficiently by one division organization?
62. How does the average length of division on the Louisville & Nashville compare with that on the Chicago, Rock Island & Pacific?
63. How is a district distinguished from a division?
64. How does the district organization of the Atchison, Topeka & Santa Fe compare with that of the Chicago, Burlington & Quincy?
65. What are the duties of the general superintendent?
66. Under the Chicago, Burlington & Quincy organization with what is the superintendent of transportation concerned?
67. Outline the functions of the mechanical superintendent.
68. What are major divisions?
69. With what is the general manager of the Pennsylvania system charged?
70. Sketch briefly the qualifications for a successful local agent.
71. Briefly describe the arrangement of the South Water Street station of the Illinois Central at Chicago.
72. Summarize the freight-house organization of this property.
73. What are the duties of the yardmaster?
74. Into what ten divisions may cars be assembled?
75. What is a "hump yard"?
76. What is understood by train-dispatching?

TEST QUESTIONS: 158

77. What are the duties of the trainmaster?
78. To whom does the chief train dispatcher report?
79. How are trainmen notified to report for duty?
80. To whom do freight train crews report?
81. What is the daily number of scheduled passenger trains at the Northwestern Terminal at Chicago?
82. What is the telautograph?
83. What system is employed at this terminal for the dispatch of trains?
84. How is the United States mail handled at this terminal?
85. With what duties is the commissary department charged?
86. Over what employees has the station master jurisdiction?
87. Who has charge of the power plant at the terminal?
88. With what is the department of maintenance of way charged?
89. In matters affecting standards of track, to whom does the division engineer report?
90. In the event of a wreck, who may have direct charge of all track forces?
91. What are the duties of the roadmaster?
92. Who has charge of the section gang?
93. What is the organization of the bridges and buildings force?
94. What are the duties of the signal supervisor?
95. With what is a master mechanic charged?
96. What division of the operating department maintains the equipment?
97. How may locomotives be classed?
98. What is meant by the term tractive power?
99. What are the two cardinal principles in car construction?
100. What object is attained by records indicating all costs of maintenance of equipment?
101. Summarize the various features of engine repairs.
102. What are the duties of the road foreman of engines?
103. What kinds of tests are conducted by the engineer of tests?
104. What are some of the reports and statistics kept by the mechanical department?
105. What is the distinction between departmental organization and divisional organization?
106. On the Pennsylvania Railroad with what is the chief of motive power concerned?

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107. Is the greater part of business of railways competitive or non-competitive?

108. What reports does the general superintendent usually receive?

109. How are these reports condensed for the general manager's use?

110. Will the cost per ton per mile on perishable freight be higher than on dead freight?

CHAPTER XII

TRAFFIC DEPARTMENT—SOURCES OF REVENUE

Although the railroads derive a considerable income from the handling of express and mail matter, sale and lease of property, and concessions at terminals and along the right-of-way, the greater proportion of their revenue comes from freight and passenger traffic.

The freight and passenger divisions in this department are as distinct from each other in the organization as was the case in the operating department, and accordingly each will be discussed separately.

FREIGHT TRAFFIC

The most important duty of the freight traffic department is the sale of transportation, the procuring of revenue-producing business, which makes the department a very important one to the company. Of all the departments this is the closest to the shipping public, as practically its entire intercourse is with the shippers and receivers of the freight.

Another important function of the department is the establishment of relations with connecting lines relative to the interchanging of freight and the apportionment of revenue on through business which will yield the greatest possible return.

It is possible for the initial line to deliver unrouted interline traffic to any one of two or more roads at various junction points under a reciprocal arrangement.

This option affords a means by which the initial line may receive in return an equivalent amount of freight from the line so favored.

Where such conditions obtain and one line at a junction point receives the greatest amount of freight from connections, the receiving line is usually designated as a preferred line or connection.

It is often impossible for another road to balance its receipts and deliveries at a given gateway except by diverting some of the traffic through other gate-ways.

The traffic department is one of observation, the systematic following of all possible sources of traffic, and constant attention to detect where unfavorable conditions are developing. The head of the department and various subordinate officials must be constantly advised through reports of traffic conditions in all territories and districts in which the home-road is interested. The personal solicitation of division, traveling, and station agents is a part of the routine work of the traffic department. Such agents and their immediate superiors are very well qualified to furnish the required reports as to home and competing roads on such subjects as the following:

Car supply—whether sufficient or not; any business loss on account of car shortage and localities and commodities most affected.

Service—whether or not deliveries are being properly made and switching service in placing and removing cars is good.

Volume of traffic by roads in and out of certain points and whether additional business has been secured or lost through the interchanging of business with connecting roads.

General conditions—probable movements of various classes of freight; crop, industrial, and like conditions.

New industries located or contemplating new locations—the local agents usually report to the division freight agent or the industrial agent on new industries and he attends to them through correspondence or personal visit.

The amount of traffic that a railroad may obtain from any given point or territory depends on the following:

- Total demand
- Competition
- Character of service, as compared with that of other roads
- Rates for transportation

It is within the province of the traffic department to increase the demand for train transportation by aiding the building up of communities located along its line. It may advertise that a community is in need of a particular industry and that conditions are favorable for economical operation and assured markets. It may advise a community of markets available for its product and markets in which it may buy needed materials. These latter functions of the traffic department are exercised through an industrial bureau, which may be attached to the traffic department or maintained as an independent bureau.

When competition for the available traffic exists, the personal element is a large factor, other conditions being equal. When shippers have a choice of two or more routes affording substantially the same class of service, there is no particular incentive to select one line rather than another except the personality or selling ability of the representatives of the various roads.

The character of service rendered is determined by the time in which deliveries of consignments may be made and the uniformity of the service. Heretofore there has been much ill-advised competition among various roads in the matter of service offered shippers. In order to secure a larger portion of business, one line inaugurates a fast train or car service between certain

points or territories. The advantage, however, is only temporary, as competing lines are compelled to give similar service to restore their parity of competition.

Uniformity of service as to the transportation properties is usually more essential than speed. There are, of course, many commodities which require fast freight service, but such service should be, and usually is, confined to such commodities.

Uniformity of service implies well-managed operation of the property as a whole and particular traffic supervision at competitive points.

The rate for transportation on standard routes in practically all instances is the same by whatever line or combination of lines the traffic may move. Commodities of low value or those distant from markets may be made to move by the application of rates considerably below normal. Such rates are entirely justifiable from the traffic man's point of view, and their adjustment at such levels as will produce a flow of traffic over the line and yield something over and above cost of service, is one of the studies of the department.

Rates are usually made by railroads acting individually through traffic associations.

This participation in rate making, either initial or in rate meetings, occupies a very large part of the time of traffic officials from the vice president in charge of traffic down to the chiefs of tariff bureaus. Many of the rates made are attacked by shippers' associations and individuals, and this involves protracted hearings before state and interstate regulating authorities and various officials of traffic departments are required to attend such hearings and very often have to prepare voluminous data bearing on the rate situation under investigation.

The work of the traffic department may be summarized in a general way as follows:

(1) Making traffic arrangements with other railroads for interchanging business at connecting points, involving compilation of statistics showing the movement of tonnage and revenue earned by different railroads at important gateways.

(2) Establishing rates, usually in connection with other railroads, involving the attendance of traffic officials at joint or association meetings and much conference work among the officials of the traffic departments of various roads.

(3) Discussing rates with shippers of certain commodities and with shippers' associations and the defence of rates before commissions, both involving compilation and study of traffic statistics and attendance by traffic officials at such meetings.

(4) Publishing new and supplementing old tariffs naming rates and other details pertaining to charges and conditions under which traffic is moved.

(5) Establishing the division of revenue between lines participating in interline shipments and handled under joint agreement.

(6) Personal solicitation of business by various agents of the company. This is one of the most important duties of the department and is participated in, directly and indirectly, by all divisions of the department, with the exception, perhaps, of the tariff bureau.

(7) Creating new business for the line by the establishment of new industries, or finding new markets for commodities originating on the line or for supplies required by industries and other interests located on the home line.

Duties of Officers

The duties of the officers in the traffic department are not as well defined and strictly limited as they are in many of the other departments of railroad work.

In the operating department the road foreman of engines supervises the work of the enginemen and firemen on the locomotives; he has nothing to do with the conductors and brakemen on the trains. The care and maintenance of the locomotives themselves is under the supervision of the engine-house foreman. The duties of each of these foremen are carefully defined and their jurisdiction specifically limited.

No such fixed and unvarying division of responsibility exists in the traffic department.

The following article by F. A. Butterworth, assistant general freight agent of the Pere Marquette Railroad, explains the duties of the several officers in the traffic department so far as they can be explained:

Anyone attempting to lay down a general rule setting forth specifically the duties of the various officials of a railroad traffic department would be confronted by the same difficulty as was encountered by a certain naturalist who was writing a textbook on the flora and fauna of Ireland. His last chapter was headed "Snakes," and the chapter was a short one, as after consulting the various authorities—both naturalists and ecclesiastical—all he could find to say under the head in question was, "There are no snakes in Ireland." Similarly there are no hard and fast rules as to the duties of the various traffic officials, and each railroad is a law unto itself.

On a typical railroad the list of traffic officials would be about as follows:

Vice president in charge of traffic

Freight	Passenger
Freight traffic manager	Passenger traffic manager
General freight agent	General passenger and ticket agent
Assistant general freight agent	Assistant general passenger and ticket agent
Coal and coke agent	
Chief of tariff bureau	

Division freight agents
General agents
Commercial agents
Foreign freight agent

District passenger agents
General baggage agent

With regard to freight traffic matters the division of work among the officials varies very noticeably, according to the individual views of the superior official. Sometimes the partition of the work is by commodities and on some roads the division is territorial. Of late years, as the supervision of traffic matters by the Interstate Commerce Commission and the various state railroad commissions has increased, many railroads have a traffic official whose duties lie wholly in looking after that branch of the work. Again, the meetings of the various traffic associations and their committees constitute a very important branch of the work and take up much of the time of the various traffic officers, and this work is divided as may be most convenient, so that it is possible only in a general way to state the duties of the various officers.

The vice president in charge of traffic, as indicated by his title, has supervision over all traffic matters, both passenger and freight, and reports to the president, to whom alone he is responsible. In a general way he indicates the manner in which the various branches of traffic work are to be divided among his subordinate officials.

The freight traffic manager has actual charge of all freight matters, and subject to the views of the vice president, takes charge himself of such particular branches of the work as may seem best, and assigns duties to his various assistants. He reports to the vice president, or, if there is none, to the general manager, or president.

The general freight agent looks after such details as are assigned to him by the freight traffic manager, to whom he reports. Some large roads have two or three, each having jurisdiction over some particular territory or some particular branch of work.

The assistant general freight agents' duties vary considerably. They may have charge of all the business on certain divisions of the road, or they may deal with certain assigned commodities over the whole system. One may have charge of the various outside contracting agencies (commercial and general agents) scattered throughout the country. Another may have to deal almost exclusively with the federal and state railroad commissions. The time of some may be largely taken up in attending the meetings of the various traffic associations, and their numerous committees. They report to the general freight agent, or to the traffic manager, according to the nature of the

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business. For instance, if the traffic manager makes a specialty of looking after grain shipments, he assigns this traffic to the assistant general freight agent in charge of through business—that is, of business originating in or destined to points beyond his road and the assistant general freight agent reports to him on such matters.

The coal and coke agent, who has charge of all the details of the coal and coke business, generally reports to the freight traffic manager.

The chief of tariff bureau's duties are in connection with the publication and distribution of freight tariffs, and he has charge of all matters relating to percentages. He reports to the freight traffic manager or general freight agent as the case may be. His duties involve attendance at many of the association meetings held for the purpose of checking in uniform rates, and under the modern methods of constructing tariffs his work is exceedingly exacting.

Thus, in the organization of the Erie Railroad (Lines West) the function of the tariff bureau is thus described:

The duties of the tariff bureau are to arrange for the checking and authorization of all rates and the compiling and issuance of all tariffs; to mail tariffs in accordance with the laws of the various states; and to issue percentage sheets and provide for the opening of new routes by the proper establishment of percentages via the various direct and indirect connections of the company.

To expedite the handling of this work the office is divided into four departments, namely:

Rate statistical department
Tariff compiling department
Percentage department
Mail department

These departments are each under the supervision of an expert in that particular line, who in turn reports to the chief of tariff bureau.

The duties of the rate statistical department are to compile all data necessary in the defense of the numerous complaints which come before the Commission; to prepare necessary statistics for rate meetings, conferences, etc.; and to analyze all special requests for commodity rates and conduct correspondence pertaining to all matters of rates.

The tariff compiling department compiles all tariffs and conducts correspondence in connection therewith.

The percentage department handles correspondence and prepares exhibits covering all matters pertaining to divisions, and

it is its duty to effect new routes, as well as to revise percentages on existing routes.

The mailing department mails all tariffs and percentage sheets and handles all requests for either tariffs or percentage sheets, in addition to the numerous details which are necessary in this line of work.

The tariff bureau comes under the direct supervision of the general freight agent and its power is mostly recommendatory, as all matters of policy in rate adjustments, percentages, etc., are usually outlined by the higher traffic officials.

On an important north and south line, having a vice-president in charge of traffic, a general freight agent, and an assistant general freight agent (handling solicitation of freight), the duties of the chief of tariff bureau are as follows:

1. To publish and distribute all freight tariffs, percentage sheets, special division sheets, and their supplements.
2. To negotiate all percentage divisions and specific divisions on commodities.
3. To make new rates on specific commodities when the general freight agent is absent, or has delegated the duty to him.
4. To advise rate quotation clerks in the office of the general freight agent.
5. To attend rate meetings.
6. To attend Interstate Commerce and state commission hearings, when delegated by the general freight agent.
7. To instruct, upon request, the clerk handling formal and informal complaints before Interstate Commerce and state commissions.
8. To handle all Interstate Commerce and state commission correspondence relating to the road's own tariffs, including Fourth Section matters.
9. To represent generally the general freight agent in his absence, or when delegated by him.

The division freight agent has charge of all freight business in a certain designated territory on his road. He deals with the shippers and receivers in his territory, and with the local freight agents on matters pertaining to freight traffic, and reports to the various traffic officials.

The general agents and commercial agents are in most cases the freight traffic representatives located at points off the road in charge of the solicitation of freight. They report usually to the freight traffic official who has charge of "outside" solicitation.

The foreign freight agent has charge of the general solicitation of all import and export traffic, and he has a regular soliciting force which is employed entirely in that connection.

He arranges steamship space for such shipments and makes

contracts with steamship companies for the rates to be charged.

He arranges for the clearances, for the preparation of all papers and documents required by government officials, and for all import and export shipments, and issues export bills of lading.

He attends to all rate legislation relating in any way to import and export traffic; that is, he prepares data and attends hearings in connection therewith.

He keeps himself advised of business conditions in foreign countries and advises shippers of such conditions and of business opportunities in connection therewith and as to the best means of taking advantage of them and the proper methods of forwarding their shipments.

Such agents are principally located at Chicago, the ports of entry on the Atlantic and Pacific Seaboard, and the Gulf ports of the Southern States.

The European freight agent is located, usually, in the capital of the European country from which his line desires to draw traffic, or in London, where he operates through assistants located in other countries. He has charge of the solicitation of shipments and the quoting of ocean and rail rates from European countries to points in the United States. He issues bills of lading and manifests for such shipments. He arranges for steamship space and makes contracts for steamship rates and prepares all clearance papers required for such shipments. He advises foreign shippers of probable markets in the United States for their products and as to proper methods to be employed in soliciting business in such markets.

The traffic department of the Erie Railroad Company was reorganized about two years ago, with the idea of attaining the highest degree of efficiency, and the present arrangement of the offices and working forces has been pronounced ideal by efficiency experts.

Under the old arrangement every official had his suite of offices, chief clerk, and working force; under the present arrangement, each official has a private office, all of which are located on one end of the floor, and the clerical forces are all together in one large room at the other end, under the supervision of an executive clerk.

All the detail work, such as quoting rates, tracing, handling claims, compilation of tariffs, etc., is handled by the clerical force in this room. The rate department quotes all rates and interprets the tariffs. The tracing department traces and diverts cars for all points reached by the Erie Railroad and connections. The claim department handles all claims, except those for personal injury which are handled by a special representative who

has an office on the same floor. The compilation of tariffs is handled by the tariff bureau force. This department also compiles division sheets.

All incoming mail is sent to the file department, where it is opened and the necessary files attached, after which it is sent to the executive clerk and his assistant for examination, and then to the department where it belongs. All outgoing mail is handled by one department in order to avoid sending more than one envelope to the same party. This also effects considerable economy in postage expense.

One system of file numbers is used on all correspondence, and all filing done in one department. If different departments are corresponding on the same subject, it is all handled on one file.

Office hours during winter months are 8:30 A. M. to 5 P. M., with a half hour for lunch, and during the summer months 8 A. M. to 5 P. M., with one hour for lunch. On Saturdays all the year round the office closes at 1 P. M. A five-minute recess is declared at 10 A. M. and at 3 P. M. every day for the purpose of thoroughly ventilating the offices and recreation.

Fast Freight Lines

In the past years an important feature of traffic department organization on the railroads east of Chicago was the fast freight lines. A fast freight line is a combination of a number of non-competitive roads forming continuous routes between points in Central Freight Association Territory and Trunk Line and New England Freight Association Territories. Each of these fast freight lines had its own separate organization throughout the states, soliciting business independently of the soliciting forces of the individual railroads. The line was in charge of a manager who reported to the traffic representatives of the various member railroads at monthly or quarterly meetings. Most of these separate organizations, however, have been done away with now, although in many cases the names of the fast freight lines have been retained on account of their advertising value.

CHAPTER XIII

TRAFFIC DEPARTMENT—EXAMPLES OF FREIGHT TRAFFIC ORGANIZATION

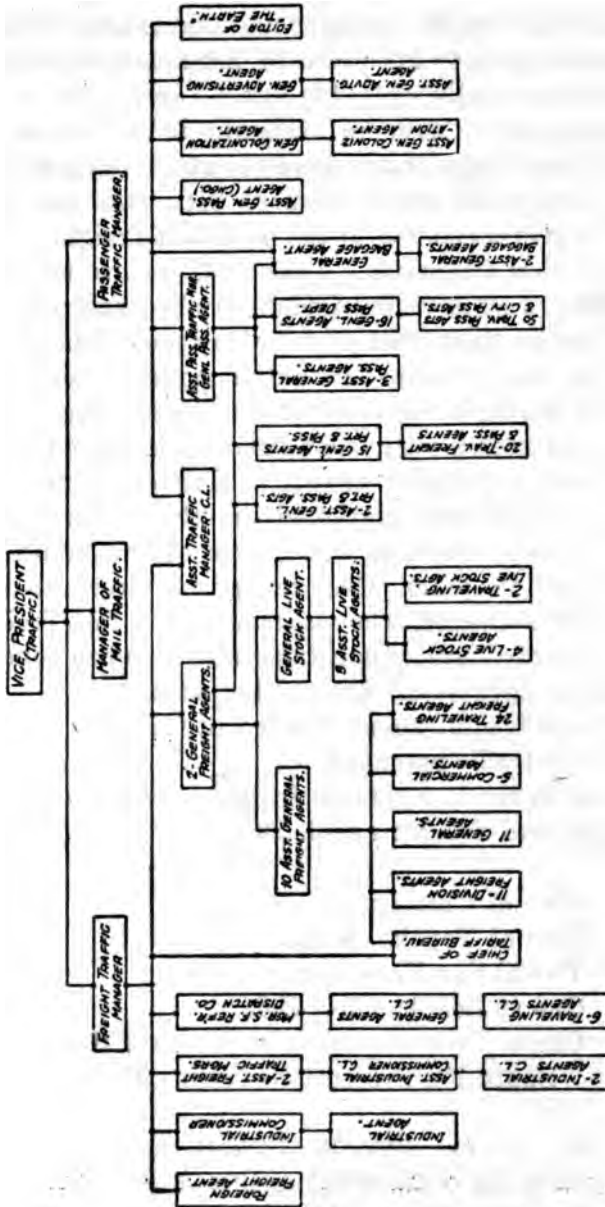
A comparison of the officers of the traffic department with those of the operating department as to their relative responsibilities is given in the following tabulation:

Traffic	Operation
Vice president in charge of traffic	Vice president in charge of operation
Freight traffic manager	General manager
General freight agent	General superintendent
Assistant general freight agent	} Division superintendent
General agent	
Division freight agent	
Commercial agent	

ATCHISON, TOPEKA & SANTA FE ORGANIZATION

Figure 18 illustrates the organization of the freight traffic department:

This organization covers approximately 9,200 miles of line. The jurisdiction of the freight traffic manager extends over all of it. An assistant traffic manager at San Francisco reports both to the freight traffic manager and to the passenger traffic manager. There are two assistant freight traffic managers, one in Chicago and one in San Francisco, and two general freight agents, one in Topeka, Kan., and one in Los Angeles, Cal., all



reporting direct to the freight traffic manager. One assistant freight traffic manager and one general freight agent are assigned to lines east of Albuquerque and the same to lines west thereof—the Coast Lines. An industrial commissioner, with an assistant industrial agent, reports to the freight traffic manager at Chicago, and an assistant industrial commissioner, with two assistant industrial agents, reports to the assistant freight traffic manager at San Francisco. That is, there are two sets of staff officers supervising freight traffic—one on lines east and one on lines west of Albuquerque—thus giving each of the two systems an autonomous organization coördinated through the head of the department.

The system does a very large business in the carrying of fruits and vegetables grown in California and the Southwest which are marketed in the Central and Eastern States. There is a manager of the Santa Fe Refrigerating Despatch Co., reporting direct to the freight traffic manager, who supervises this fast freight traffic. Connected with this refrigerator line are general and traveling agents—all Coast Line officials.

The foreign freight agent, located in Chicago, reports to the freight traffic manager.

Reporting to the two general freight agents are eleven assistant general freight agents, viz.:

Five at Chicago,
Two at Topeka, Kan.,
Two at San Francisco,
One at Los Angeles, Cal.,
One at Prescott, Ariz., in charge of the
Santa Fe, Prescott & Phoenix Railway.

There are eleven division freight agents, eleven general agents, six commercial agents, and twenty-four traveling freight agents reporting to the assistant

general freight agents. It will be observed that this division of supervision is on a territorial basis.

As to a large part of its length this system traverses the cattle country of the West and the Southwest, which accounts for the large organization supervising live stock traffic. The general live stock agent with an assistant is located at Kansas City, Mo., and he has in addition two other assistants. There are four live stock agents and two traveling agents reporting to these.

The chief of the tariff bureau reports both to the freight traffic manager and to the assistant general freight agents.

It is to be noted from the diagram that there are certain officials in the service of both freight and passenger departments. There is an assistant traffic manager (Coast Lines) reporting to both freight and passenger traffic managers, two assistant general freight and passenger agents, and fifteen general agents reporting

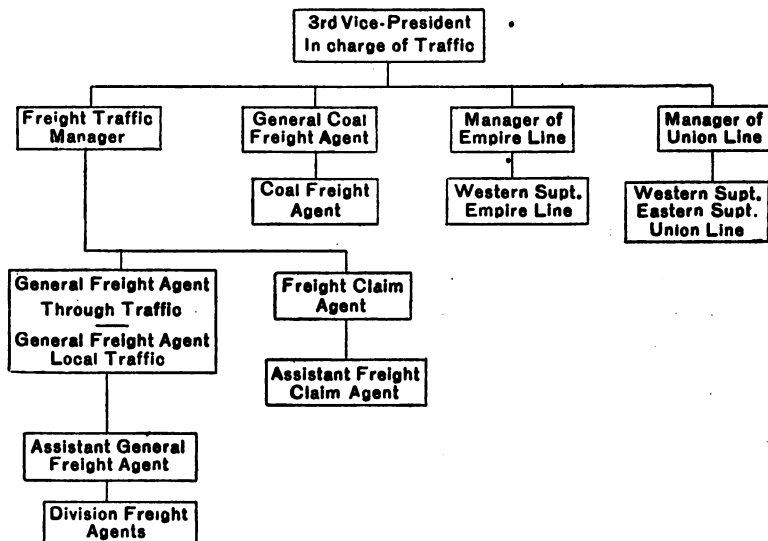


FIG. 19.—Organization of the Freight Traffic Department of the Pennsylvania Lines East of Pittsburgh

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both to the general freight and to the general passenger agents, and there are twenty traveling freight and passenger agents reporting to these general agents.

PENNSYLVANIA RAILROAD ORGANIZATION

Figure 19 shows the organization of the freight traffic department of the Pennsylvania Railroad, Lines East of Pittsburgh.

It will be noted that the division of authority in the freight traffic department of the Pennsylvania Lines is made on the basis of character of traffic to a much greater extent than that of the Santa Fe, whose organization is mainly on a territorial basis.

On the Pennsylvania, one general freight agent has charge of through traffic, another of local traffic, still another of coal traffic. The fast freight traffic is likewise separated from other classes of traffic by being placed in the hands of two independent managers reporting directly to the vice president. That is, the freight traffic department of the Pennsylvania is very highly specialized—to a greater extent perhaps than that of any other organization in the country.

In addition, the freight traffic department has what is in effect a representative in the operating department. The superintendent of freight transportation reports to the general superintendent of transportation of the operating department and has charge of the handling of cars at all stations and the responsibility of seeing that such cars are moved promptly.

ORGANIZATION OF THE FREIGHT TRAFFIC DEPARTMENT OF THE NASHVILLE, CHATTANOOGA & ST. LOUIS RAILWAY

The organization of the freight traffic department of this line (1,230 miles) illustrates what is usually found on the smaller systems. (See Figure 20.)

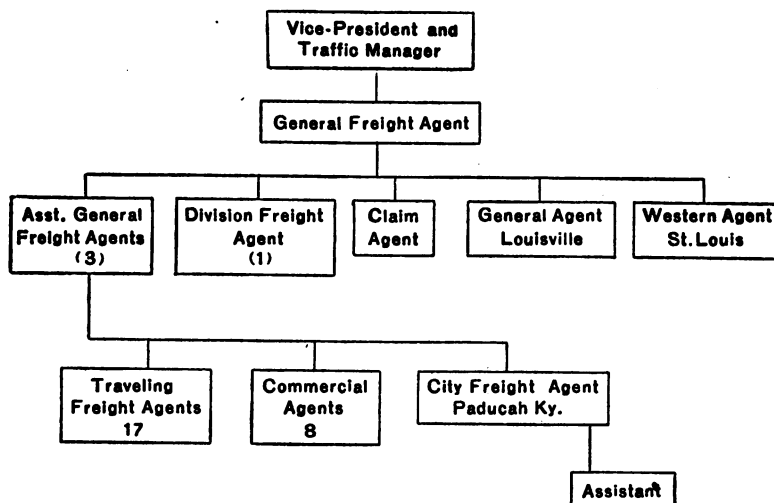


FIG. 20.—Organization of the Freight Traffic Department of the Nashville, Chattanooga & St. Louis Railway

Five of the commercial agents are in cities located on the system. There is one each in Chicago, Kansas City, and Jacksonville, Fla.

STATISTICAL CONTROL

The compilation of statistics made from the station agent's monthly abstract of way-bills for "freight received" and "freight forwarded" shows the tonnage and revenue of the traffic received and forwarded from each station on the line. A monthly statement for each operating division is prepared and comparison with the previous month and the same month of the preceding year by stations and divisions shows at once any increase or decrease in business and indicates where it has occurred. On some roads, notably the Atchison, Topeka & Santa Fe, a statement is prepared showing the tonnage and revenue by commodities received and for-

warded at each station. Comparisons on this basis with previous performance indicate whether or not the traffic from certain "lines of business" is increasing or decreasing. These statements serve to verify or disprove to a large extent the reports of traveling freight, division, and station agents, heretofore referred to, and furnish a very good general check on the efficiency of the soliciting force.

They show also the interchange of business with foreign lines at junction and connecting points and furnish the data for determining the condition of inter-line traffic and whether the home line is getting its fair proportion of business at such interchange points.

There are large movements of traffic between territories which pass through certain gateways and it is necessary to know not only the traffic of the home road through them but its relation to the traffic of other lines working through the same gateways. Certain railroad associations gather the data necessary to show the condition of such traffic, the Chicago and Ohio River Committee being one of them.

This committee publishes certain tariffs for its member railroads naming rates between the Chicago District and contiguous territory and certain gateways which are known as the Ohio River Crossings; viz., Cairo, Ill., Brookport, Ill., Evansville, Ind., New Albany, Ind., Jeffersonville, Ind., Louisville, Ky., and Cincinnati, Ohio. It receives from all lines working through these gateways, tissue copies of way-bills covering shipments received or forwarded through them. An analytical statement is prepared under the supervision of the chairman of the committee showing, among other things, the tonnage and revenue received by each line on business to and from these gateways.

Other associations perform similar service for member railroads at other gateways. The information indicates

to the traffic officials of all roads the condition of their business in relation to the total and to any competitor in which they are particularly interested. It also indicates to a traffic manager whether or not certain portions of his traffic, whose routing he can control, should continue to be routed through certain gateways or be diverted to others where he may increase his interchange business by making such diversion.

Statistical control is exercised in the administration of the traffic department to as large an extent as in the operating department, which has been heretofore described.

TARIFF BUREAU

The compilation and publication of tariffs is one of the most important duties of the traffic department. As the work involved is of an entirely different nature from the solicitation and other branches of traffic work heretofore described, this section is included to define the general work of this bureau.

On smaller roads and in some instances on the larger ones, there is no such officer as the chief of tariff bureau nor a separate bureau with a distinguishing name, the work being performed under the supervision of the general freight agent or of an assistant general freight agent in connection with other general office work. The work to be done is the same, however, whatever the title of the officer in charge or the designation of the division responsible for its performance.

There are two distinct divisions of the work in every tariff bureau; viz., the compilation and publishing of the tariffs naming the rates, rules, and regulations governing the transportation of freight, and the preparation of division sheets showing the division of the revenue accruing to each railroad participating in the movement of

all shipments between points on the home and those on foreign lines.

In many bureaus there is a third and very important division known as the connecting line department. This subdivision has in charge the work of examining the tariffs and special division sheets of connections of the home line in which the home line participates. The examination is for the purpose of determining if the home line has been accorded full representation to all points to which it can handle the traffic covered by the schedule and if the proper junction points have been used. No small part of the work of this division is to see that connections furnish proper special division sheets where the regular or agreed percentages do not apply.

The basis for the rates on interline traffic actually published is determined by joint action of all interested lines and the divisions of revenue are generally on a percentage basis for merchandise traffic. On such low-grade commodities as lumber, salt, drain tile, stone, and coal, there are often arbitrary divisions; that is, the originating or delivering roads or both demand a certain arbitrary proportion per 100 pounds, or per ton, to or from junction points. These percentages or arbitrary divisions are compiled and published in the division sheets and are used in the accounting department (auditor's office) as the basis of settlement between all roads on interline traffic.

The tariffs themselves, in addition to naming the rates between all points in the territory they cover, must show all participating railroads and their concurrences in such tariffs, and must state definitely all rules regarding minimum weights and such matters and all conditions under which freight is received for transportation. It is hardly necessary to add that the compilation of tariffs and division sheets and the issuing of supplements thereto, when rates or conditions are changed,

involves very careful clerical work and much checking to insure their accuracy.

In connection with this work there must be maintained a file not only of all tariffs and division sheets of the home line but of other lines in whose tariffs the home line concurs, also a file of similar publications of all other lines in the territory whose rates may in any way affect the home line. The maintaining of these files is one of the duties of the tariff bureau.

Ordinarily the only sharp division of the work of the bureau is between work on tariffs and that on division sheets. Some roads, however, on account of their traffic location, divide the work on a territorial or commodity basis. The Illinois Central has an organization divided on a territorial basis. Its line lies in Western Trunk Line, Central Freight, and Southern Territories. The tariff bureau of the northern portion of the system has (1) what is called the Central Freight Association and Eastern Points division, whose work is confined to rates and divisions on traffic between Illinois points and points named in the title; (2) a Western division, whose work is confined to traffic between Illinois points and points on western roads—west of the Mississippi River; (3) a Southern division, whose work is confined to traffic between Illinois and western points on the one hand and southern territories on the other.

On the Chicago and Eastern Illinois there is a division of the bureau whose work is confined to lumber rates and divisions only. Each of these divisions is in charge of a division clerk with several compilers and clerks under him, the number of course depending on the size and number of the tariffs handled.

The chief of tariff bureau's duties vary widely on the several roads. In all cases he has general supervision of the compiling and publishing of tariffs and division sheets.

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On most roads he attends the association meetings and other conferences when joint rates are under discussion. On some roads, notably the western constituent roads of the New York Central System, he has the authority to state at such conferences the rates and divisions his road will accept, without confirmation of the general freight agent or traffic manager; on the other roads he acts only on specific instruction from his superior as to each point involved; in some instances he attends meetings merely for the benefit of the discussion in relation to rates, the actual naming of the rates and divisions of his road being delegated to other traffic officials.

In some tariff bureaus there is a quotation clerk whose duty it is to quote rates on request from employees in the accounting, claim, and other departments of the home road, and from station agents, shippers, and others interested in any freight rates published by his road.

CHAPTER XIV

TRAFFIC DEPARTMENT—PASSENGER TRAFFIC

This department has charge of all details relating to passengers, including baggage, mail, express, and milk service on passenger trains in some instances. It is charged with obtaining a large part of competitive business and developing as much new business as is practicable.

The organization's functions, duties, and responsibilities are not as clearly defined as those of other departments. It is the selling organization endeavoring to get the business and works much as other business selling organizations do.

It has such definite duties as printing tickets, distributing them, and instructing agents in regard to their preparation, sale, and use; fixing rates within limits allowed by the traffic division or rate-regulating bodies; and arranging the division of revenue with other carriers which participate in business extending beyond its own lines; handling baggage and collecting excess charges; and advertising for patronage of the passenger service.

On many roads the immigration bureau is included in this department, as well as commissaries for the operation of dining-car service and depot lunch rooms and general supervision of eating houses controlled by the company, where such is required.

In arrangement of passenger train service and schedules, the head of the department is vested with a con-

siderable measure of authority. With the operation of trains, however, he has nothing to do.

As the revenue from passenger train service is, as an average for the whole country, about twenty-eight per cent of the total earnings from operation, the responsibility of the department is large. The New York, New Haven & Hartford Railroad obtains about one-half of its revenue from passenger service, and the average for the New England States as a whole is about forty-five per cent. Passenger traffic is of less relative importance on western roads, but earning as it does so large a percentage of the revenues on all roads, it is no slight element in the situation.

Its problems vary, however, with density and character of population. In the older portions of the country the duty of this department consists largely in keeping a long-established service running smoothly and reducing cost to the minimum consistent with good service. In a less thickly settled community with small towns and an agricultural population largely in excess of urban population, the problem is different and the margin of profit in the business small. Often passenger trains must be run with a view to future earnings rather than to present profits. Sometimes trains are run for the benefit of the other departments, such as the freight, in order to gain the good will of shippers in competitive territory. That is, the passenger department must in some instances be used to develop or hold the business and benefit the road as a whole rather than limit its service to legitimate demand based on direct returns from such service itself.

In the case of lines extended into territory but little developed, an actual loss must be incurred in making rates so low that prospective settlers may be brought out to look at the "new country," with a view to developing new business nonexistent at the time. Much of this has

been and is still being done by the roads operating west of the Missouri River and in the Southwest.

The problem of excursion rates is always present and requires solution. Rates which are well advised in some circumstances will not be in others and care must be exercised in making such rates that they do not seriously affect other situations in which reductions are not justified. The making of excursion rates for merchants' fairs, Mardi Gras, state fairs, and such occasions, is justified and profitable, but such reductions have often been the basis for ill-advised rates having no justification whatever.

Another class of business of much the same nature is the reduction for conventions of various kinds. Often reduced rates are asked for by various associations, and in many instances the amount of business will justify the reduction and in others it will not. It requires judgment and experience to decide in which class the application belongs. In all such cases, however, the net results to the roads participating in the rates should be profitable.

In addition to this supervision of special rates there is, of course, the matter of division of rates with other lines in the regular course of business and in some instances (as between Chicago and New York) arranging for such differentials as the necessities of the road and its service require.¹

The duties of *the passenger traffic manager* may be given as a summary of much of what has just been said. He is the head of the department and responsible for passenger train service and for all traffic that is handled by it.

¹ Much of the data contained in the foregoing section is taken from a paper written by Mr. Percy S. Eustis, passenger traffic manager of the Chicago, Burlington & Quincy Railroad, for *Railway Organization and Working*, edited by E. R. Dewsnap.

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Such train service must be adjusted to the needs of the traveling public and be conducted for the benefit of the railroad as a whole, often necessitating coöperation with the freight department in many matters.

Passenger train schedules are made by the passenger traffic manager in coöperation with the operating department, although he has nothing to do with the actual operating of passenger trains. In making the schedules, he must consult with the operating department as to running time, equipment, and facilities.

Making arrangements with connecting lines for interchange of business and establishing through routes of travel is one of his chief duties and involves as well the division of the rates.

The decision as to the reduction of rates below the regular tariff schedule is his, usually in conference with similar officials of other lines in the same territory, through associations similar to the freight traffic organizations.

The dividing of his advertising appropriation among the various mediums available, such as newspapers, booklets, folders, bill boards, and maps, is a matter of first importance, in which he will be assisted by the head of his advertising division.

Supervision of the soliciting agents of the road must be exercised by him through representatives whom he appoints for the purpose and generally through periodical written reports as to general and special conditions affecting the passenger traffic both along his line and in territories situated at some distance from it in whose traffic he participates.

Often his road maintains an immigration bureau under his jurisdiction for the purpose of stimulating the settlement of the country traversed by his line.

Ordinarily he supervises the handling of baggage through a baggage department in direct charge of a

baggage master, who prescribes rules for handling baggage, collecting for excess baggage, and adjusting claims for loss or damage to it, all with the approval of the head of the department.

On very large roads the commissary department may be separate, but usually general supervision of it is vested in the passenger traffic manager, for while it is seldom a source of profit its conduct affects passenger traffic directly, beneficially if properly conducted, otherwise if not.

Mail and express traffic are usually under the supervision of the passenger department, as the greater part of the business is handled by passenger trains. It is sometimes in charge of an officer reporting directly to the president or some one of the vice presidents. The compensation for carrying mail is fixed by law, and the express business is usually done under a contract for so much space in express car or a certain percentage of gross express revenue. Even so the compensation and the percentages require adjustment at times, in which the passenger traffic manager will generally participate.

The *general passenger agent* is the representative of the passenger traffic manager in certain designated territory. He reports to the traffic manager and has general supervision of the employees and work of the passenger department in his territory. On the smaller systems having no passenger traffic manager, he reports to the general manager or the president direct. On still smaller roads the general freight and passenger agent has charge of both freight and passenger traffic.

Assistant general passenger agents usually have jurisdiction over some particular class of traffic, as organized party traffic.

District passenger agents work within a certain defined territory, principally with the station agents of

the home line. They are the "outside" representatives of the general passenger agent among the home line agents and aid them in handling passenger traffic, including instruction in the preparation and sale of tickets, keeping of records and reports, and obtaining prospective business. They confer with local interests in the adjustment of time schedules to local needs and other matters of local interest. They have immediate supervision in some instances of the traveling passenger agents engaged along the line of the home company.

Traveling passenger agents work with the agents of foreign lines—except those reporting to the division freight agent of the home lines. The various passenger officials receive many inquiries as the result of advertising, and the traveling agents attend to these personally when circumstances require. They, like the soliciting agents of the freight traffic department, have many "leads" which they follow in much the same way that salesmen in mercantile lines do. Some of these work under the direct supervision of the general passenger agent, others under the general or special agents of the home company located in territory distant from the home line. The duties of all of them are the same, however, as they are the active selling force of the passenger department.

General agents usually have charge of both freight and passenger traffic in certain defined territory, usually not situated on the line of the home road. They canvass their territory through traveling freight and passenger agents, regularly calling on the agents of foreign lines and attending to such inquiries and following such leads as they receive.

Figure 21 shows the organization of the passenger department of the Chicago, Burlington & Quincy Railroad, a system comprising 9,339 miles of line:

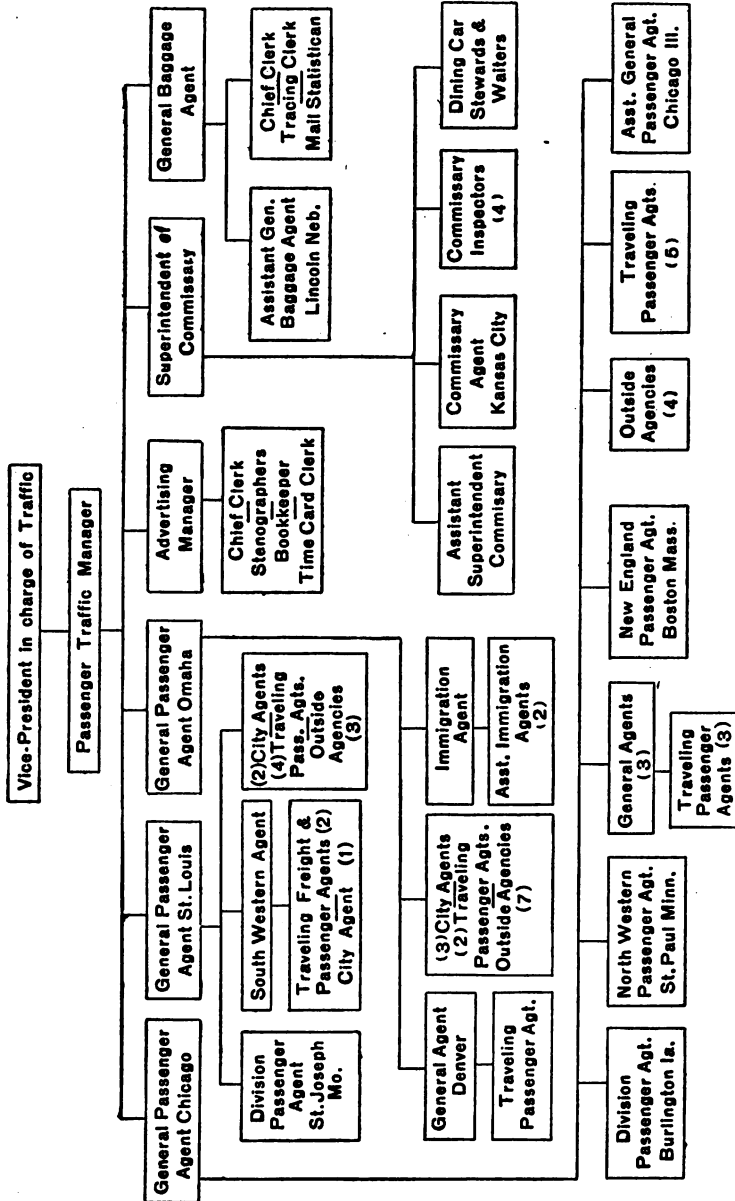


FIG. 21.—Organization of the Passenger Department of the Chicago, Burlington & Quincy Railroad

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There is a vice president in charge of traffic to whom the freight traffic manager and the passenger traffic manager report. Reporting to the passenger traffic manager are six officials, as shown on the chart. While the advertising manager spends a very considerable amount of money in the aggregate during the year, his organization is a small one.

The superintendent of commissary has charge of the obtaining (through the purchasing department) of all dining-car supplies and the operation of the dining cars; that is, the preparation of menus and serving of meals on such cars. He has a general assistant at Chicago and another at Kansas City, as the mileage of the system is so great that more than one assistant is required to give the close supervision this class of service demands. In addition there are four inspectors on the road constantly to insure good service by frequent detailed inspection.

The general baggage agent has supervision of all baggage, mail, express, and milk carried on passenger trains. He has an assistant stationed at Lincoln, Neb. The baggage agent arranges for the space required by the government for carrying mail, receives and answers complaints, and attends to all fines imposed by the Post Office Department on account of delayed mail, and such matters. He makes regulations in regard to handling baggage by train baggagemen and station agents and the collection of charges for excess baggage. His office force consists of a chief clerk, stenographer and clerks, tracing clerk, and mail statistician. All claims for loss of or damage to personal baggage carried in baggage cars are handled by him.

There are three general passenger agents reporting to the passenger traffic manager. One assistant general passenger agent located in Chicago has entire charge of the soliciting and handling of "organized party

traffic;" that is, of large bodies of members of associations attending conventions and meetings. In this connection he is advised of convention dates, names of officials of organizations, and data essential to the conduct of such business, and arranges for the equipment required in moving this class of traffic. He reports to the general passenger agent at Chicago.

The general passenger agent at Chicago is in effect an assistant passenger traffic manager, acting for the head of the department during his absence. Reporting direct to him are the following officers, in addition to the assistant general passenger agent just mentioned:

Division passenger agent located at Burlington, Ia.

Northwestern passenger agent located at St. Paul, Minn.

New England passenger agent located at Boston, Mass.

Three general agents.

Five traveling passenger agents.

Outside agencies, located at points not on the home line.

Two of the general agents have three traveling passenger agents under their supervision.

The general passenger agent at St. Louis has reporting to him the following officers:

Division passenger agent located at St. Joseph, Mo.

Southwestern passenger agent located at Kansas City, Mo., who has two traveling passenger agents and one city passenger agent under his supervision.

Two city passenger agents, one in St. Louis and one in Cincinnati.

Four traveling passenger agents.

Outside agencies.

The general passenger agent at Omaha, Neb., has the following officers reporting to him:

One general agent, located at Denver, Colo., who has one traveling passenger agent under his supervision.

Three city agents.

Two traveling passenger agents, one of whom acts as division

passenger agent among the station agents of the home line for about one-half his time and as a traveling passenger agent on foreign lines for the other half.

An immigration agent, who has two assistants reporting to him. This agent in connection with the advertising manager in Chicago plans advertisements in rural journals calling attention to the advantages of irrigated and other lands available for settlement. He visits communities in answer to replies received from these advertisements and canvasses districts and rural communities for prospective settlers on new lands located along the lines of the home road. He arranges home-seekers' excursions, usually two a month, during the seasons when farmers have completed their work, for the purpose of allowing those interested to visit the "new country" cheaply. He or his assistant personally conducts such excursions and makes arrangements for trips for such home-seekers through the country for the purpose of demonstrating its advantages.

An exhibit of the agricultural products of the lands along the home line is maintained in Chicago for the benefit of city workers who may be attracted to settlement of new cheap lands.

The Chicago office of the passenger traffic department has a strikingly compact organization with some rather unusual features. All the general officers of the department and their employees are, in effect, in one very large room, which facilitates intercommunication among the several divisions of the department and avoids much of the "lost motion" which is unavoidable in less favorable situations. While each division maintains its own files and preserves its autonomy to a large extent, this arrangement is peculiarly favorable to the coördination of the work of all divisions.

One chief clerk acts for all the three chief passenger officials; viz., passenger traffic manager, general passenger agent, and assistant general passenger agent. One messenger and one stenographer force are organized as one unit serving the three main divisions of the office. Usually each of these three officials has his own chief clerk and separate office organization.

ADVERTISING FOR PASSENGER TRAFFIC

While the advertising division of the passenger department is not a large one numerically, its work is most important in the solicitation of competitive business, and a short description of its work is added here.

In the last fifteen years radical changes have come about in railroad advertising. There have been two principal causes: first, the abolition of the practice of paying commissions to agents of foreign lines for business routed over the home line; second, the action of the Interstate Commerce Commission in prohibiting the practice of paying for newspaper advertising with transportation.

There is no incentive for the selling agent now, as there was formerly, to route the business over any particular line. For that reason he is appealed to through advertising and the personal solicitation of the traveling passenger agent. The former practice of paying for newspaper advertising with transportation was very extensive, especially as to the country papers, all of which carried time-tables and reading notices. As a general proposition this was an arrangement of considerable benefit to the railroads, but much of it was looked after only indifferently and it was a very common occurrence to see display advertisements in the country papers advertising some special event for two or three weeks after that particular event had become history. In the metropolitan papers display advertisements were paid for in cash and reading notices in transportation usually.

Railroad advertising is prepared for two classes of people: the traveling public and railroad agents, both of the home and foreign line. In general the same mediums used by other selling organizations are employed by the railroads.

The agents are appealed to mostly through the mail, by means of mailing cards or leaflets. These contain notices of reduced rates on account of special events or particular locations, as summer resorts, Panama Exposition, Yellowstone Park, Grand Canyon, opening of some particular piece of government land for the public entry, and inauguration of the president. In such advertising the *rate* is the prominent feature rather than the railroad making it. Time-tables of the home road also are sent regularly to the agent list. Framed pictures or maps carrying the advertisement of the home roads are sent to agents at the more important cities.

All advertising plans must provide a system of "following up" the advertising. In railroad practice this is done through the traveling passenger agent, who calls on the foreign agents periodically.

The time-table folders are the most important single feature of the advertising, with newspapers and magazines following closely. All this is now paid for in cash, and the sums so employed during the year are often very large. The public in large cities is appealed to through the metropolitan dailies, the rural public through the "mail order weeklies" as they are called, whose subscribers are made up entirely of "out-of-town" people, and generally through such publications as the Saturday Evening Post and the monthly magazines, the cost of these last being greater than that of any other form of advertising.

In addition some "free" advertising is occasionally secured from the newspapers through sending notices of interest to the public as to some event or new feature pertaining to the road, and on rare occasions editorial comment in influential papers on such features. Such editorials or notices, especially when they contain catch

phrases, are reprinted and sent out with all United States mail of the company.

Electric signs, bill boards, and street cars are employed by some roads to a very large extent. Lectures are given at fairs, land shows, and other gatherings on such subjects as cattle raising in the Northwest, truck farming, dry farming, irrigation, and places of interest (as Glacier Park, Colo., and California). This latter feature of advertising is not so common now as formerly.

Preparing advertisements, making contracts for them, and checking up to see that they appear and are displayed as agreed upon, is special work and is taken care of by a bureau in the passenger department.

RAILWAY PASSENGER ASSOCIATIONS

There are many associations of this kind in the country and their work is of the greatest importance to the passenger traffic departments of the railroads. The Central Passenger Association of Chicago is the largest and most important of these. Its territory is practically the same as that of the Central Freight Association and its work in relation to passenger traffic is much the same as the work of that association in relation to freight traffic. A detailed description of its organization would be anticipation to a large extent of what will be said of the freight association and is therefore omitted.

CHAPTER XV

TRAFFIC DEPARTMENT—AUXILIARY DEPARTMENTS

There are a number of departments and associations which may or may not be under the jurisdiction of the traffic department, but which in any event are utilized to a considerable extent by that department in securing additional business and adjusting differences between the road and its patrons.

FREIGHT CLAIM DEPARTMENT

The claim department is handled in various ways by individual railroads. In some instances it is in the legal department entirely. In others, loss and damage and overcharge claims are handled by the traffic department and personal injury by the legal department. On some roads, the loss and damage claims are handled in the traffic department and overcharge claims in the accounting department. On the Chicago, Rock Island & Pacific Railway and some other roads, loss, damage, and overcharge claims are handled by the accounting department and personal injury claims by the legal department.

In whatever way it may be arranged, the adjustment of all claims, except perhaps those covering personal injury, involves the coöperation of the traffic and auditing and often the legal department.

The claims for losses occasioned in transportation of property fall into one of the following divisions:

(1) Loss of property, which the company fails to deliver.

(2) Damage to articles while in possession of the company.

(3) Charges collected in excess of legal rate (called overcharge claims).

The investigation of claims prior to settlement with the owner of the property has in the past occasioned many embarrassments to the carriers, through the diversion of business to competing lines by aggrieved individuals, and consequently it is of the utmost importance that claims be settled as promptly as possible.

In some cases after a claim has been investigated and the voucher issued in favor of the claimant, the voucher is given to the traveling or soliciting agent to deliver to the claimant. This affords an opportunity to solicit additional business at the time of his visit.

Figure 22 shows a typical organization for the freight claim department.

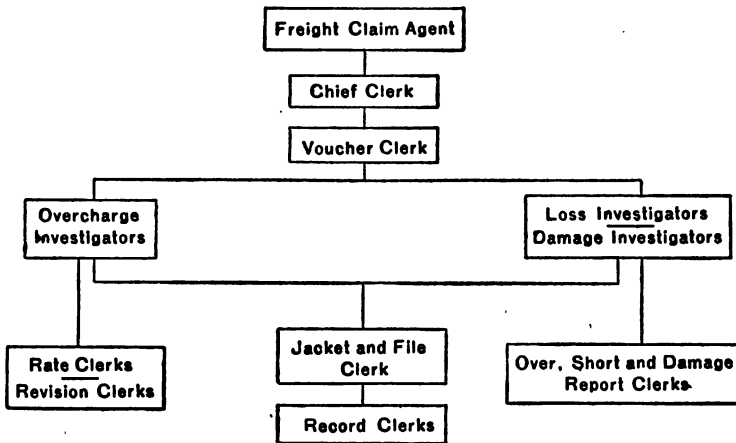


FIG. 22.—Typical Organization of a Freight Claim Department

The freight claim agent exercises general supervision over the department, passing upon such claims as are particularly vexatious and conferring with the legal department when necessary, attending the periodical

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meetings of the freight claim association of which he is by virtue of his office a member, and acting sometimes as a member on one or more of the standing committees of that association.

The voucher clerk prepares vouchers in favor of the claimants.

The loss and damage investigators specialize in claims where there has been loss or damage to the property tendered the carrier for transportation.

The overcharge investigators handle all claims where it is alleged that the carriers or their connections have exacted from the owner of the property a sum in excess of that lawfully established by the tariff applicable thereon.

INDUSTRIAL BUREAU

Often the industrial bureau is in charge of industrial officers independent of the traffic department. The work of the bureau is so intimately connected with traffic work that it is discussed here. The bureau gathers all facts and statistics relating to the natural resources of territory tributary to its line, supplementing this with a study of markets for various commodities which may be produced economically from such resources. These facts it proceeds to advertise by correspondence and personal work among corporations and individuals engaged in the production and sale of such commodities.

The bureau maintains intimate relations with manufacturers and large shippers on its line, reporting as to sources of supply of raw materials used by manufacturers and markets for products of factories located on the line. In connection with this work, all information as to climatic conditions available, labor rates of wages paid, sources of supply of fuel or power and its cost, and all other conditions affecting the manufacture

or distribution of commodities are compiled and presented to those who are interested in the territory from an industrial standpoint.

Not infrequently this involves a large survey from the traffic department standpoint and the preparation of data showing rates on inbound commodities and rates on manufactured products to the more important consuming points throughout the United States.

PURCHASING DEPARTMENT

This department is not under the jurisdiction of the traffic department. The officer in charge, that is the purchasing agent, reports to one of the chief executives, his purchases being made on requisitions.

The railroads are the largest consumers of a great many articles of commerce. Rails, ties, stone, cement, and the like, as well as thousands of other articles that enter into their activities, are purchased by them in immense quantities.

The prices on these commodities in many instances being the same, railway contracts are often let on recommendation of the traffic department to industries or manufacturers that are favorable to the road and who in return route a considerable portion of their business over the lines of the carrier in question.

RAILWAY FREIGHT ASSOCIATIONS

Reference has been made in the preceding pages of this chapter to associations of railways and their participation in the making of rates, divisions, and such matters. There are many associations of this kind in the country and their work is of the greatest importance to the traffic department of all railroads. The Central Freight Association, with offices in Chicago,

is one of the most important, from the standpoint of volume of tonnage and revenue of the member lines, and a description of its organization, purposes, and work will convey a very good idea of the work of them all.

Central Freight Association

The following, taken largely from the "Articles of Organization" of the association, explains its membership, territory,¹ and purposes, and the duties of its members:



FIG. 23.—Map Showing Central Freight Association Territory

Purposes of the Association

The purposes of this Association are:

To enable the members to confer, advise, and coöperate with each other and with other roads upon the subjects of divisions

¹ The association is composed of roads located within the territory shown on the sketch map (Figure 23) drawn from the description contained in the "Articles."

of through rates, statistics, classifications, rules, regulations, and inspection, and to secure to the members the interchange and promulgation of authentic information in regard to the traffic and tariffs of rates of the respective parties, and to aid in securing compliance with the laws of the states, and of the United States relating to and regulating commerce.

The members, for the purposes aforesaid, agree:

(a) To submit all questions of common interest upon which action is desired to the association, to be considered promptly under its rules.

(b) To arbitrate all differences upon questions coming within the scope of this agreement which are not otherwise properly reconciled.

(c) Each member agrees that it will send to the chairman two copies of each local and joint state and interstate tariff of rates and of changes therein, also classification and rules at the time of making, issuing, or filing the same with the Interstate Commerce Commission; also of all agreements or arrangements with other common carriers in relation to the rates and divisions upon traffic coming in whole or in part under this agreement, when such arrangement or agreement is entered into.

Chairman.—The executive officer of the association is the chairman. He presides at meetings of the association and represents it in all negotiations with other associations. All communications regarding division of rates between lines in other associations and this association are through the chairman. He compiles and issues the statements, statistics, and joint publications authorized by the association.

In case of disagreement in any committee on a subject upon which prompt action is required the question at issue is submitted to the chairman for decision. On objection by any member to this decision the matter is referred to the association.

Other Bureaus and Committees.—The association maintains the Central Freight Association Inspecting and Weighing Bureau and in coöperation with other associations maintains the Official Classification Committee.

The Chicago & Ohio River Committee, the Michigan Freight Committee, the St. Louis Eastbound Freight Committee, and the St. Louis-Cincinnati-Louisville Freight Committee are the large standing committees of the association. There are also committees at junction points to handle local matters, each with a chairman and secretary. The major committees maintain separate organizations under the supervision of officers as follows:

Central Freight Association Inspection and Weighing Bureau, chief inspector.

Chicago and Ohio River Committee, secretary.

Michigan Freight Committee, chairman.

St. Louis Eastbound Freight Committee, chairman.

St. Louis-Cincinnati-Louisville Freight Committee, chairman.

Standing Committees.—The titles of the committees of the association with an explanation of their functions will indicate the work covered by the association.

The membership on the various committees noted following is made up from the traffic officials of member lines. They are selected by the association in general meeting, due consideration being given to the interests of the various carriers. For instance a railroad operating in Michigan would not be accorded representation on the committee on relation with southern roads or a strictly Indiana line on the committee on relation with trunk lines for the reason that the traffic officials of such lines would not be in close touch with any of the matters which would ordinarily come up. Neither would a coal-carrying road be assigned to the lumber committee.

The rules and regulations committee considers and recommends for association action all rules and regulations governing traffic movement except rates—such as minimum weights, weighing cars and contents, estimated weights, milling-in-transit, fabrication, and extension of through billing arrangements and storage.

The lumber committee considers and recommends for association action rates on lumber and forest products; the salt committee on salt; the iron and steel committee on iron and steel and articles manufactured therefrom; the live stock, packing-house products, grain and grain products committee establishes rates on these commodities; the brick committee on all clay products, sand, and gravel; the coal and coke committee has jurisdiction over rates on gas house coke or by-product coke—it has no jurisdiction over coal or furnace coke rates; the lime committee over rates on lime; the uniform basis of rates committee has jurisdiction over rates which are not subject to the jurisdiction of any of the foregoing committees.

The coal and coke committee considers and recommends for association action matters of all natures pertaining to coal and coke traffic. The large coal carrying roads have a general coal and ore agent who represents his line on this committee.

The committee on relations with western roads considers and recommends for association action the establishment of all through rates, rules, and matters on interchange traffic in both directions between Central Freight Association roads and their western connections.

The committee on relations with southern roads considers and recommends for association action such matters in both directions as to southern roads.

The committee on relations with trunk lines (Eastern Trunk

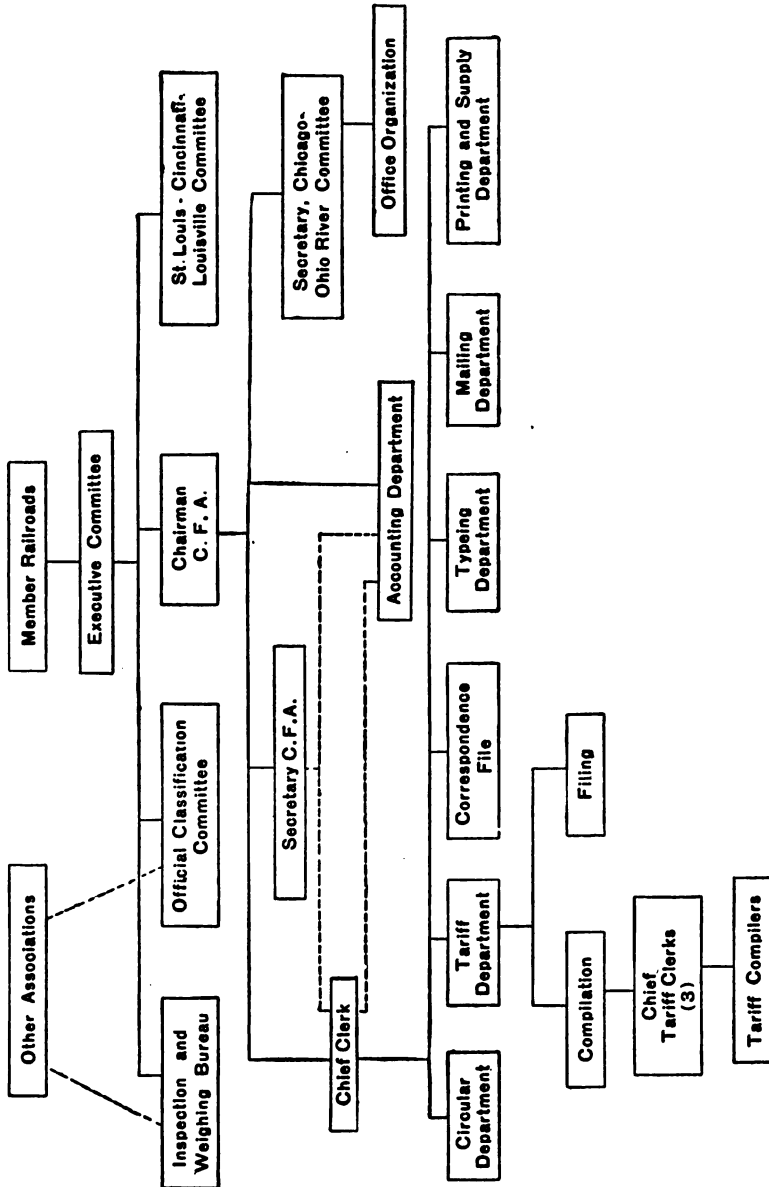


FIG. 24.—Organization of the Central Freight Association

Lines) considers and recommends to the association for action such matters on eastbound rates only as to eastern lines.

The eastbound percentage committee has charge of the grouping of points in the percentage groups in Central Freight Association Territory whose eastbound rates are based on a percentage of the Chicago-New York rate.

The uniform basis for rates committee considers and recommends to the association for action all propositions involving an advance or reduction in rates. This is probably the most important of all the standing committees of the association.

These committees have jurisdiction over the divisions of rates between Central Freight Association and other territories but have none over division of rates between points both of which are situated in Central Freight Association Territory.

Office Organization.—The action of these several committees and of the association itself—termed for convenience “association legislation”—is incorporated in the form of printed “Information Circulars” which are sent to the various officers of member railroads.

The association, for its member railroads, and in coöperation with other associations, compiles and publishes certain “agency” tariffs and it must in consequence maintain a very considerable tariff bureau. In addition, notices of meetings, dockets, and other matters relating to association and committee meetings and conferences necessitates a rather extensive organization for printing, mailing, and typing work.

Figure 24 shows the office organization required in performing the work mentioned:

The secretary is in effect a vice chairman of the association and presides over many of the association and committee meetings. In addition, he is chairman of the very important standing switching committee, of which all roads entering Chicago are members and for which he issues switching tariffs.

The accounting department reports to the chairman, the secretary, and the chief clerk on various matters of accounting.

The chief clerk is responsible for the management of the office force and its discipline. He attends to a large part of the office correspondence, has general supervision of all of it, and in addition has charge of certain specified subjects. When the exigencies of the service require it, he acts as chairman of committee meetings.

The circular department has charge of the preparation of the “Information Circulars” advising members of association legislation.

The weighing and mailing of Information Circulars, notices of meetings, docket advices, proceedings of meetings, tariffs, supplements, and division sheets to members (and to a large list

of foreign roads and shippers as to tariffs) is in charge of the mailing department.

The printing department is provided with mimeographs, duplicators, and multigraphs and does practically all the association printing except tariffs and supplements. The chief of this department also has charge of the purchase and distribution of office and printing-room supplies.

CHAPTER XVI

ACCOUNTING DEPARTMENT

HISTORICAL

For the reason that in connection with this course there has been prepared a work dealing with railway accounting, much of the detail that might be incorporated in this chapter has been omitted and will be found in the other work.

In the earlier history of railroads, freight accounts were kept in the offices of the general freight agent and passenger accounts were kept in the offices of the general passenger agent, disbursements in the superintendent's office, and other accounts in various traffic and operating departments. Summaries of these were sent to the treasurer or some other designated officer who issued periodical statements showing the net results of the operation for the property as a whole. These statements, coming from such divergent sources, lacked uniformity, and intelligent comparisons were impossible. The need of a central authority where all accounts could be carefully supervised and compiled on a uniform basis (in order to conserve the revenues of the company and record data for useful comparisons of all departments with each other, with past performances, and with other companies) resulted in the establishment of the accounting department.

Prior to 1880 each railroad treated all other railroad companies practically as it treated any other shipper, requiring invoices or manifests of shipments tendered

it, in much the same way as it required the shipping ticket of a business house, and in delivering a shipment to another railroad it required the payment of charges at the time of the delivery in the same manner as from other consignees. Passengers were interchanged by the use of coupon tickets, but there was no uniformity of method in settling such interchange of business among the railroads.

Interline billing (billing of freight moving over two or more roads) was inaugurated to reduce expense and avoid delays and oftentimes blockades at interchange points. This system has grown so that much the larger part of freight moving over more than one railroad is handled on through way-bills, reading from point of origin to point of destination, without regard to the number of roads participating in transportation. This interchange has necessitated a uniform system of accounting, which has been inaugurated largely through the American Railway Accounting Officers' Association, to which the chief accounting officers of practically all the railroads of this country belong. It has, also, through establishing uniform accounting methods, made the statistics of various railroads comparable one with another.

GENERAL

The accounting department certifies to the correctness of all figures of revenues and disbursements and prepares the entries which appear in the company's general books. It prepares all statistics and figures required by the Interstate Commerce Commission and much additional statistical information used by heads of departments responsible for the economical operation of the property. The relation between the accounting department and the board of directors and heads of operating departments is most intimate.

Auditing, as distinguished from accounting, determines this accuracy. The reports of all revenue-receiving by this department as well as pay rolls, vouchers, and statements of amounts due to and from other corporations and individuals, accounting for the revenue and disbursements, involve the handling of a great mass of detail which must be checked and prepared for the entries in general books of the company.

The organization of the accounting department falls under three main heads—receipts, disbursements, and general accounting. The department of receipts is subdivided into passenger, freight, and miscellaneous revenue, with a division officer in charge of each; disbursement accounts sometimes are subdivided into motive power accounts and maintenance of way accounts.

There are two main objects to be attained by any system of railway accounting: first, to safeguard an account for all revenue received and paid out or disbursed; second, to have a complete record of all transactions involving such revenue.

Under receipts are classified all earnings from transportation of freight, passengers, mail, express, baggage, milk, and the like, and the system of accounting provides for reports and remittances, which show that all revenue due has been collected by agents, conductors, and others and has been accounted for by the auditors and turned over to the treasurer. All money paid out by the company is likewise shown by receipted voucher or other evidence of payment, giving all details of the nature and amount of the payment, name of payee, and other information, so that a complete history of each separate payment of money is recorded.

COMPTROLLER

Generally speaking, the comptroller has supervision of all accounts and statistics, and prescribes the system

under which they are kept, and he has the power to enforce such regulations and rules as he may make in maintaining his system of accounting, and to demand from any official or employee such specific information in regard to matters affecting accounting as he may require. He is charged with the duty of furnishing the board of directors with a report of all receipts and disbursements and preparing such statements and statistics as they may require.

He maintains a record of all securities owned by the company and examines all securities in the custody of the treasurer or trustees of various funds at stated intervals—usually once a year—having the power to do so at any time. At stated intervals, usually during a three months' period, he checks the treasurer's cash actually on hand and his bank deposits. He verifies the correctness of the treasurer's daily reports of receipts and disbursements.

The general ledger which records the net results of all transactions of the company is kept in the comptroller's office and receipted vouchers which have been paid by the treasurer are kept in the files of his department.

When they are properly certified to by the authorized officer he approves all pay rolls, vouchers, loss and damage and overcharge claims, and the statements of amounts due by or to other companies on account of traffic and equipment service.

He has charge of the fidelity bonds of all officers and employees of the company. He has the power of appointing all officers and employees in his department.

AUDITORS

Reporting to the comptroller, or to a general auditor, are two classes of auditors: viz., those having charge of receipts and those having charge of disbursements.

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In its simplest form the accounting department usually has an auditor of freight receipts, an auditor of passenger receipts, and an auditor of disbursements. On many systems there is a further division of accounting. From the description of various organizations given later it will be noted that the Pennsylvania Railroad has six auditors and the Union Pacific System a general auditor with five auditors and one assistant auditor, reporting to the comptroller.

Auditor of Freight Receipts

This auditor is responsible for the enforcement of the regulations and the rules as to reports and returns from officers, agents, and all employees of the company having anything to do with the freight traffic accounts. He prepares the statements showing the amounts due to or by agents or other railroad companies and individuals on account of freight traffic.

Statistics

For statistical and other purposes, the earnings and expenses are sometimes determined separately for each operating division, the auditor making a separate division balance sheet. These reports show not only the freight moving between stations both of which are on the same division but between the stations under consideration and stations on other divisions and on foreign roads. It is made up by combining the station agent's report of the home road and the carbon copies of the way-bills of the foreign lines, or abstracts of them.

In addition statements are made giving the total tonnage of each class and of selected commodities carried, the total receipts, the total mileage per ton of freight and other statistical information required by operating and traffic officials.

There is no established or uniform rule for making the apportionment by states. When required it is usually figured either on a rate prorate or on a mileage prorate. If a shipment is between two points, both of which are in one state, no division is necessary. On a shipment from, say, Chicago to Denver, which moves in the four states of Illinois, Iowa, Nebraska, and Colorado, the total earnings are apportioned among the several states on the basis of the mileage traveled by the shipment in each state, or the rates making up the through rate. Such apportionments are valuable not only from a statistical standpoint, but for the purpose of taxation in those states where railroad companies are taxed on the basis of gross earnings.

These separate monthly reports of all agents must be gone over as many times as there are different classes of figures to be compiled. This involves an immense amount of labor and to simplify the work many accounting departments use what is known as the Hollerith machine.

This machine punches holes in the figures printed on a card, a card being punched for each way-bill. Stations and commodities are given certain numbers. Weights, dollars, cents, and dates can of course be easily expressed in numbers, so that the way-bill can be duplicated in all details, by punching the proper printed figures out of the card. The cards are then run through a "sorting" machine which takes out all those having like information, as from the same station, or for same commodities. A boy can handle between ten thousand and fifteen thousand cards per hour on these machines. Such cards can then be totaled by another machine which will handle from four hundred to six hundred cards per hour for any desired set of figures, such as pounds, or dollars and cents.

From the daily "freight received" reports, through

the use of these machines, the daily freight earnings can be very closely approximated; within one per cent on the Pennsylvania. The published weekly earnings of that railroad are compiled in this way.

Auditor of Revenue

The auditors of freight and passenger receipts on a small system keep the accounts with the agents of their company. On the larger systems there is an intermediate auditor of revenue, between the auditors first mentioned and the comptroller (or general auditor). The statistics compiled from agents' reports by the first-named auditors go direct to the general auditor, but the accounts dealing with revenue derived from freight and passenger traffic come through the office of the auditor of revenue. He keeps an individual account with each agent in a set of ledgers. The agent is debited with the balance against him as shown by the statements of the auditors of freight, passenger, and miscellaneous accounts and is credited with cash remittances as shown by the treasurer's statement. The balance is brought down and the sum of all these balances is shown in the general balance sheet as "Amounts due from agents or others."

Auditor of Disbursements

This auditor has immediate charge of all accounts relating to disbursements. He examines all bills for which vouchers are drawn, and pay rolls, and certifies them to the comptroller (or general auditor). He distributes all disbursements made to their proper accounts and prepares a monthly statement showing the amount chargeable to each of the items as prescribed by the classification of the Interstate Commerce Commission.

All railroad disbursements are finally resolved into two classes: material and labor. As used in railroad accounts, all payments other than those made on the pay roll are treated as material; even in the case of contract work which involves practically nothing but labor—as in a grading contract—so far as the accounting is concerned, it is treated as material.

The auditor in accounting for disbursements under the heading of material has to do with vouchers, drafts, bills, and material distribution.

The statistical division of the auditor of disbursements furnishes the cost of various items by operating divisions (sometimes divided between main and branch lines) and districts—the operating division being that in charge of one set of division officers and the district being that portion of the road under the jurisdiction of the general superintendent, comprising from three to six such divisions.

Operating accounts are subdivided to determine various things of interest to officials charged with operation; for instance, the unit cost per train, ton, or passenger mile, for station service, yard service, engine service, train service, and such data. These are prepared for the current month and are compared with the previous month, and with the same month of the preceding year, serving as an index to the relative efficiency of the present as compared with past performances. The officers at the head of the operating department use these unit costs in judging also of the relative efficiency of the officials on one division with those on another, the figures being prepared as stated for each division separately.

It also prepares a statement of the performance of each locomotive as to miles run, fuel and oil used, and other data, for the purpose of comparing one engine with another, or one type of engine with another type.

Outside Supervision

In order to insure the carrying out in practice of rules which he establishes for making proper returns to his department, the auditor employs traveling auditors, who instruct various employees of the company in matters relating to such rules and returns. In addition, at irregular intervals, the accounts of station and other agents are audited by them to determine their accuracy.

Train Auditors

The following is a description¹ of a passenger train audit system in use on several large railroad systems, which will serve to show the methods employed by the accounting department in determining that all revenue due is in fact received by the company.

Conductors are required to have in their possession at all times checkable evidence of the transportation of every passenger on the train; each train auditor carries a commission of authority signed by the operating vice-president and the general auditor, upon exhibition of which the conductor will permit him to take and examine all forms of transportation in his possession and the records in connection therewith. The train auditors may board trains at any point and having made a count of the passengers then on the train, see that all are accounted for. Before leaving the train the auditor fills out his report showing the condition of the transportation and records, and gives the conductor a copy of it.

Tickets of ordinary issue are treated in the usual manner, but for the purpose of assisting the conductors, and as far as possible reducing their work in connection with tickets honored but not taken up, local tickets have been provided, having conductor's train checks, which are to be detached by the conductor for his run, the check detached being accepted by the train auditor as transportation for the passenger. Book tickets, upon which the destination is to be written or stamped, and some forms of local tickets are also provided with train checks to be handled in the same manner as card tickets. Mileage detach-

¹ *Railway Age Gazette*, January 17, 1913.

ments and cash fare receipts are handled as usual. Pass signature slips are required of all holders of annual passes and of all trip passes which are not taken up by the conductor. The conductor is required to show on a form "Transportation honored, but not taken up" all tickets not provided with a check to detach showing the initial and destination of ticket, form, and number.

The check is made absolutely in the open, thereby removing the odium that has frequently been connected with the checking of passenger trains.

VALUATION

[The following on Valuation was written for this publication by Mr. E. Holbrook, special engineer for the Union Pacific and Southern Pacific Railway Systems.

He has supervised the valuation of about 25,000 miles of railroad during the past few years. His experience covering many years as an engineer and manager, responsible for the construction, maintenance, and operation of important railroad properties in connection with his work in the valuation field has given him the reputation in railroad circles of being one of the best authorities on valuation in the country.]

Railroad valuation is as yet in a nebulous condition, but probably it will eventually require a distinct department in railroad organization, reporting to the executives, or there may be simply a set form of reports made by the auditor or comptroller, the details of which will be supplied by the heads of departments.

Valuation work is at present used in connection with various leases, contracts, assessments, rate cases, and state and federal valuation, which may be used for various purposes. Just now federal valuation overshadows all the others and determines to a great extent what the organization for valuation work shall be.

Valuation Engineer

Valuation work, so far at least as determining physical facts is concerned, is usually placed under the general

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supervision of an official designated as the *valuation engineer*.

At the present stage of development of valuation, its principal elements are supposed to be found in connection with the original cost to date of the property or in the estimated cost of reproduction. There is a confusion between the terms *cost* and *value* and a failure to recognize the difference between a property which as a whole is perpetual in nature and its transitory parts or one which comes to an end, such as a hotel or factory. The result is that to date most valuations made have been very crude pieces of work in which value has been taken to be almost, if not quite, the aggregate of the cost of the physical items, diminished according to some crude theory of depreciation. It is apparent that to obtain the physical facts required for valuation, an engineer of wide experience in construction and maintenance work is necessary. Usually the man best qualified for the work will be found to be the chief engineer or engineer of maintenance of way, or some assistant who can work under their guidance. So we come to have the valuation engineer.

Valuation Committee

The physical facts sought by the valuation engineer will be found recorded either on maps, profiles, and plans, or in the records of the chief engineer, engineer of maintenance of way, superintendent of motive power, comptroller, auditor, purchasing agent, store keeper, or operating division organization, or must be found by field investigation.

It is therefore important that the valuation engineer have a staff or committee to coöperate with him. Such a body is called the valuation committee. It is usually composed of heads of departments, legal, accounting,

land, etc., with the valuation engineer as chairman. They meet to discuss principles of valuation, ways and means of prosecuting certain phases of the work, and especially the coöperation between the various departments, and the assigning to each of the work it is to do. This committee may meet at regular intervals or at the call of the chairman. It should be a most important body and should not be large, but every member should be a worker and keep himself thoroughly informed as to the developments and the requirements of the work. Heads of departments other than those on the committee may be called to confer with it when matters are being considered which concern their particular departments.

Working Force

The valuation engineer usually has an office and a field force, with an assistant in charge of his office with general supervision over its members. He usually has an office engineer who directs the technical work to be done by the office force. This force is more or less specialized as statisticians, draftsmen, computers, stenographers, etc., and is otherwise assigned to certain lines of work, such as obtaining information (historical, descriptive, quantitative, and financial) as to land transactions; working on bridge and structural problems; or providing grading or shop machinery and tools, or equipment. Each of these requires men specially fitted by past experience in connection with the departments involved.

Field Work

When records fail to disclose all the information required, field work must be resorted to to supply it. Frequently plans, profiles, and records of original con-

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struction have been lost or destroyed, making necessary a complete resurvey and mapping of the line, together with computing of all quantities, costs, etc. In most cases a partial record exists which must be supplemented by field work involving an investigation into abandoned property or into hidden quantities in foundations and elsewhere, or complete notes of structures and parts of the property.

The federal valuation field force has roadway and track parties who cross-section cuts and fills, test alignment, classify materials, check plans of tracks and signals, etc., noting any facts not furnished by the records; structural parties to examine bridges and buildings, checking the same with the plans if available, taking the necessary measurements, and obtaining all information available for original cost or estimated cost of reproduction; land parties who examine all lands of the railroad as well as adjoining lands, checking the areas from maps and examining records of transfer or assessment; equipment field parties to obtain the necessary valuation data not found in records as to equipment and also examining it as to its condition; shop machinery and tool parties to investigate this subject and other special parties as the work may require. There may also be a committee on unit prices to examine into the condition of prices of various items of expense including transportation. In the case of small or local valuation jobs, a single party under a competent head may obtain all these various kinds of necessary information.

Pilots

When federal field parties are working on railroad valuation, it is necessary to supply them with such maps and plans as are useful and also to point out any hidden

quantities, or, to them, unknown difficulties that have been encountered in construction; also to guard against the omission of any items of expense or value. Therefore a pilot thoroughly equipped for this purpose is of great importance. He should be familiar with the requirements of the particular phase of work upon which the party is engaged as well as with the particular property upon which he is working. He should spend considerable time in advance of the actual valuation work in getting and arranging the information required.

Valuation is a special work and should not be called engineering nor given any other designation than valuation, though it requires a knowledge more or less extensive of engineering and other departments of railroad work.

It is frequently better therefore for the valuation force to get its information directly from the records of the department concerned with the help of a pilot belonging to the department than to ask the department for it, because the investigators understand better what is wanted, and at the same time it puts them in better shape for any future defense of their work that may be required. As an example: Federal Valuation Order No. 14 requires information as to purchase price of various materials bought during a period of ten years. This requires information from the accounting, engineering, mechanical, store, and transportation departments. It has been found advisable in some cases for the valuation force to go directly into the records of these departments with the help of a pilot, rather than to attempt to explain to all departments what is wanted. The information so obtained from the various departments is then put into a single statement.

Size of Field Parties

For field work of almost any kind the minimum size of a party is three. Two men are usually required to get the information by measuring or otherwise and the third to record it. If cross-sections, signals, bridges, buildings, etc., are to be taken, measured or recorded, twos and threes will be required for each set of operations to be carried on simultaneously. To carry on all the field work or roadway and track investigations simultaneously, a party of considerable size is necessary. Usually it is found advisable to use a camp train which can be moved from station to station as required, with computers and draftsmen to work up and check the notes as work progresses. The use of camp trains also makes it possible to have at hand, in convenient shape, as many plans, profiles, drawings, and reports as may be necessary without danger of losing them, and the evenings offer an opportunity for conference between the outside and inside forces under the direction of the chief of the party, making it possible to clean up the work as it progresses, which cannot be done if the notes of field work are sent to a distant office.

CHAPTER XVII

ACCOUNTING DEPARTMENT—EXAMPLES OF ACCOUNTING ORGANIZATIONS

The following examples of various accounting organizations will be instructive in connection with the foregoing discussion.

PENNSYLVANIA RAILROAD ACCOUNTING ORGANIZATION

The statement of the duties of the comptroller heretofore made will answer for the duties of the comptroller of the Pennsylvania Lines. Under the comptroller are a deputy and an assistant comptroller to whom six auditors (Figure 25) report, viz.:

- Merchandise accounts
- Coal traffic
- Passenger traffic
- Miscellaneous accounts
- Disbursements
- Union line

The auditor of merchandise accounts has immediate charge of all accounts relating to freight traffic, other than coal and coke. The auditor of coal traffic has charge of accounts relating to coal and coke. The auditor of passenger traffic has charge of all accounts relating to passenger traffic. These three auditors report to the auditor of miscellaneous accounts. He is in effect auditor of receipts for the system earnings, as in addition to the general supervision over the

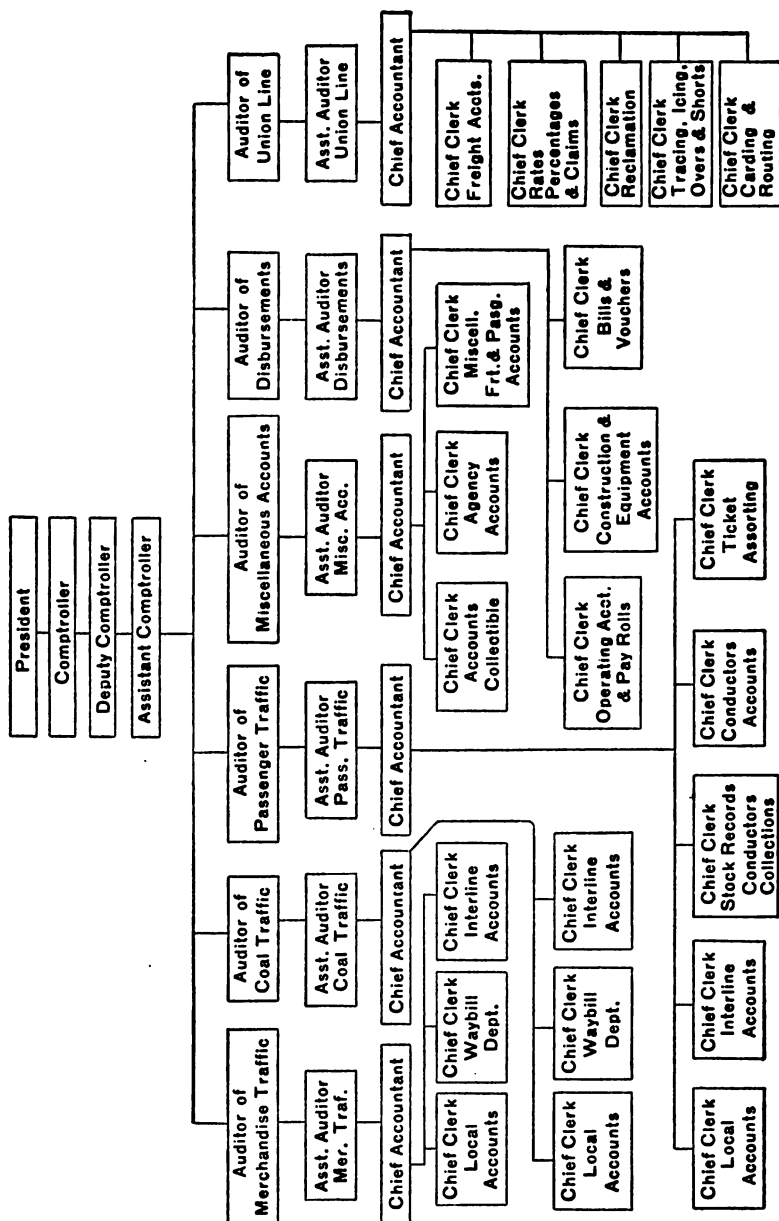


FIG. 25.—Accounting Organization of the Pennsylvania Railroad

three auditors named he has immediate charge of accounts relating to mail, express, military transportation, rents, telegraph receipts, equipment, demurrage, and all other revenue except strictly passenger and freight.

He is responsible for the prompt settlement of all claims of the home company against other companies and individuals.

The duties of the auditor of disbursements are the same as those previously described.

The auditor of the *Union Line. (fast freight line) has charge of all accounts for both revenue and expenses of these lines, and of the division of the revenue. He prepares vouchers for loss and damage and overcharge claims on the *Union Line traffic and apportions all expenses among the roads over which such traffic passes. He furnishes all interested officers of the *Union Line with a report on division of expenses and revenues and statistical information. He also furnishes the auditor of miscellaneous accounts a statement of amounts due to and by agents.

This organization of the accounting department, like that of the traffic department, is based on the *character* of the traffic. The Pennsylvania Railroad East of Pittsburgh moves an enormous tonnage of coal and coke; hence an auditor to attend specifically to that traffic. In connection with other lines it moves a large fast-freight business between the Central States and Eastern Territory and has an auditor, who is an auditor both of disbursements and of receipts, in charge of accounting for this business only.

UNION PACIFIC ORGANIZATION

In the Union Pacific organization chart (Figure 26) it will be noted there is an auditor of equipment and

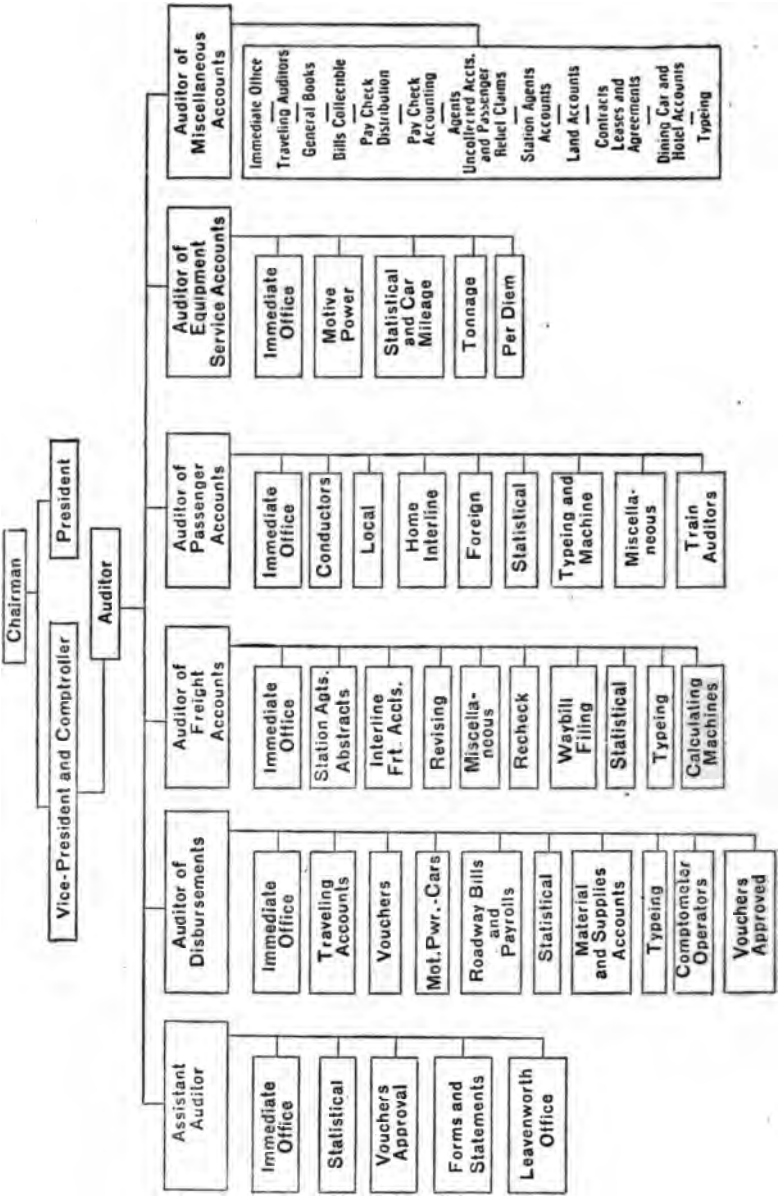
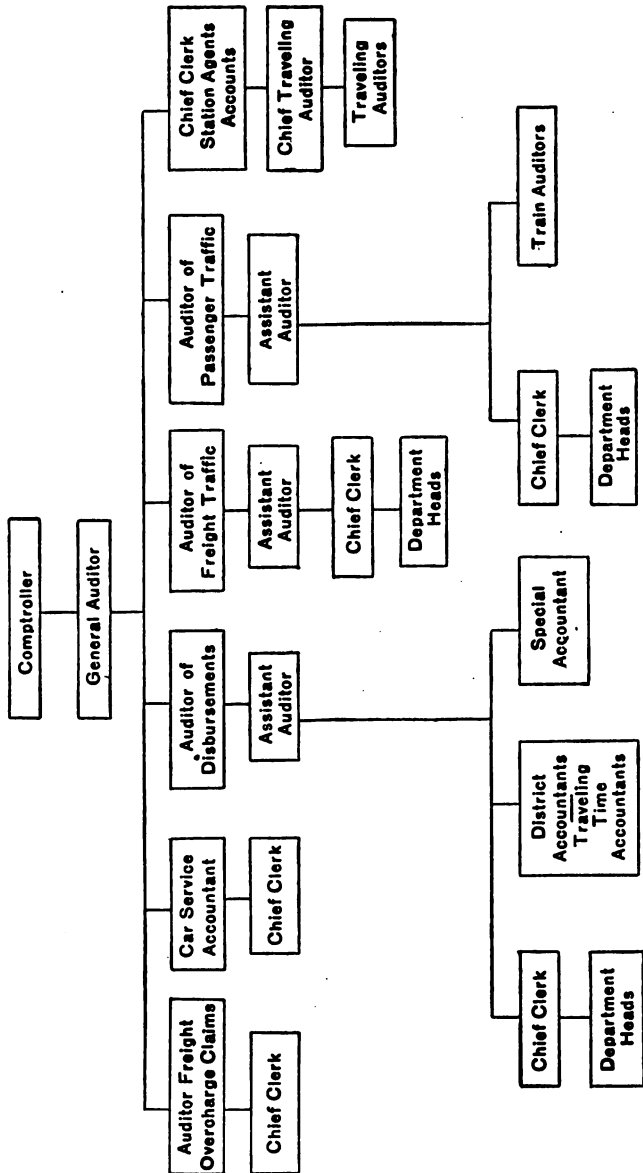


Fig. 26.—Accounting Organization of the Union Pacific Railroad



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service accounts. In addition to the actual accounting of car service, the statistical work of this department is considerable, as car distribution is very closely watched on the Harriman Lines, of which the Union Pacific is a constituent part.

CHICAGO, ROCK ISLAND & PACIFIC RAILWAY ORGANIZATION

The head of the accounting organization is the comptroller with a general auditor reporting to him. Reporting to the general auditor are three auditors and the heads of three departments.

The freight claim department on this road is in the accounting organization. There is an assistant claim agent with a chief clerk and office organization similar to that shown as typical in the chapter on the freight traffic department.

The car service accountant reports directly to the general auditor and has charge of all accounts relating to car service, switching reclaim, per diem, and relations with other railroads arising from the use of cars of the home and foreign lines.

The station agents' accounts are in charge of a chief clerk in the general auditor's office. The traveling auditors, who make the station audits, are under the direct supervision of the chief traveling auditor, who reports to this chief clerk.

Each of the three auditors has an assistant with a chief clerk, to whom the department heads report. The different divisions in each auditor's department, which are in charge of these department heads, are not shown in Figure 27 as they are practically the same on all roads and are shown in detail in Figure 26—Union Pacific Railroad—such as vouchers, statistics, revising, rechecking, filing, and interline accounts. The train

auditors report to the assistant auditor of passenger traffic.

It will be noted that the auditor of disbursements has district accountants and traveling time accountants reporting to him. These accountants check up division and district offices in the same way that the traveling auditors check station agents. At irregular intervals they check these division records of vouchers and pay rolls, the traveling time accountants confining their check to the pay rolls and the district accountants to all other expenditures. The great extent of the territory covered by the system probably explains the necessity for this close supervision of expenditure by the general office of the accounting department.

CHAPTER XVIII

MISCELLANEOUS DEPARTMENTS

REAL ESTATE AND TAXES

The railroads are very large owners of real estate and in consequence pay large sums in the way of taxes on account of such ownership. They also rent or lease much of their property to corporations and individuals having transportation connection with them, and in turn rent or lease real estate from corporations and others under some circumstances. The real estate and tax agent is charged with the supervision of all matters pertaining to these subjects. In some instances there are separate officials for real estate and taxes, but usually supervision is vested in one officer.

The real estate agent is the custodian of all original copies of deeds, releases, leases, maps, and records of real estate. He prepares a descriptive list of all real estate owned by, leased by, or leased to his company. He examines and approves all deeds, leases, and agreements relating to real estate before they are executed and recorded, and attends to the actual recording of such documents. Purchases and leases of all property are negotiated by him. He furnishes other officers of the company abstracts of any real estate documents required in the conduct of their departments.

He prepares for each state a separate list of real estate subject to taxation. He examines all assessments for taxation, special assessment taxes, water rents, and other municipal charges.

He examines and certifies the correctness of all bills against his company for purchase of real estate, all taxes and other assessments, state or municipal, against the property, rents for property leased by the company, interest on real estate mortgages, and all other charges and expenses incurred on account of real estate owned or leased. He collects all rentals or charges due his company from others, remitting such receipts to the treasury and reporting all such transactions to the comptroller.

INSURANCE DEPARTMENT

Some of the larger companies have an insurance department which is operated on about the same basis as the ordinary insurance company. The several departments are charged a percentage on such structures as would ordinarily be insured, and the money so obtained is set aside to create a fund from which structures destroyed by fires may be replaced.

The larger the system (and the greater the number of risks), the nearer the approach to the conditions under which the insurance companies operate, which is a large number of widely separated risks. The insurance companies charge a higher rate than the average fire loss of the territory in which they operate; the railroad company's insurance department saves the profit of the insurance company.

Where large and costly structures are owned they are usually insured in outside companies, just as insurance companies reinsure such risks.

Even the larger systems cannot afford to do without either the insurance in regular companies or insurance funds of their own, as fire losses would cause violent fluctuations in expenses or even financial embarrassment in the case of very serious fires.

The department usually provides for inspection and instruction to prevent fire losses, and such structures as shops, freight houses, and docks, are provided with fire-fighting equipment and sometimes with fire companies organized from the company's own forces engaged at or near the particular structure.

TESTING DEPARTMENT

The testing of various materials and railroad supplies is assuming great importance. The Pennsylvania Railroad has just completed new laboratories and buildings for testing purposes. The organization and working of the department of tests is given in an article by Mr. C. D. Young, published in the *Railway Age Gazette*, of July 2, 1915, from which this account is written.

The Pennsylvania Railroad has found that the quality of the material purchased for use in track, bridges, cars, and locomotives must be carefully scrutinized. Control over the quality of supplies is secured by the aid of specifications, which are based upon careful consideration of the materials available for the various uses of the railway, and by research work tending toward the development of new materials and devices, or improving those which are in general use. An organization with laboratories at a central point is essential in promoting the work of thorough inspection.

Physical Laboratory

Among the machines and apparatus that compose the equipment of the physical laboratory, are the following:

Five universal tension and compression testing machines, one of 1,000,000, two of 300,000, two of 100,000-pound capacity.

One vibratory endurance spring testing machine of 75,000-pound capacity.

One 43-foot drop-testing machine.

Two vibrating staybolt testing machines.

One Brinell hardness testing machine.

One 2,000-pound cement testing machine.

One horizontal microscope, with camera for metallographic work.

One grinding, buffing, and etching outfit for the preparation of samples for microscopic work.

The physical laboratory is provided with various machines for making tension, compression, drop, vibratory, and hardness tests. There are in addition engines, lathes, drills, etc., and special machines for testing hose, rubber, and other materials.

The materials for test are samples which have been obtained by the inspectors at outlying points and those sent to the department by the shops. The metal specimens go to the machine room for preparation, then to the physical laboratory for analysis.

Rubber, Air Brake Hose, and Miscellaneous Laboratory

The extent of the work of this department is indicated by the fact that the needs of the Pennsylvania Railroad are about 635,000 pieces of air brake hose per year.

Heat Treatment Laboratory

This department is for the development of standards in the heat-treatment of metals during the process of their manufacture for use in railway equipment. Investigations are carried out to study the effect of various heat treatments on a large variety of carbon and alloy steels.

Large castings of various kinds have been heat-treated by this department with the aid of outside facilities with a gratifying degree of success. The effect of chemicals and heat-treatment upon the endurance of materials to repeated stresses is tested out by revolution and vibra-

tion tests, including vibration tests on complete springs. Rails, splice bars, and tie plates are heat-treated to study the increased service it is possible to secure.

Insulating Tests

Investigations are made on various types of fireproof material for the purpose of maintaining a high standard. The testing of felt and insulating papers used for lining refrigerator cars has been made necessary by the large variety of materials of this kind on the market, the keen competition among manufacturers, and the ease with which the highest grade and best material can be closely imitated by cheap and inferior products. This laboratory is equipped with an insulated room and electrical heating arrangements for this work, the tests being designed to represent as nearly as possible the service conditions to which these materials would be subjected.

Lamp Tests

The equipment for lamp tests consists of three photometers, a lamp-test rack of 1,000 lamps capacity with switchboard, transformers, and potential regulator equipment. These lamp tests are made with a view of obtaining data for the preparation of specifications to secure uniformity in the ordering of incandescent lamps, and the maintaining of sufficiently high standards. There is a department investigating electrolysis, electrical machines, batteries, and other electrical material.

Laboratory Work

A large room is provided for the force of laboratory and road assistants coming under the direction of the foreman of road tests and special tests. The duties of

these men are varied and include tests of locomotives on the road: tests of equipment with special devices; the tonnage rating of trains; and the following up of all experimental appliances which are put into service for test purposes.

Metallurgical Work, Etc.

The main chemical laboratory is divided into two departments, the larger one of these being devoted exclusively to metallurgical chemistry.

The smaller of these two laboratories is for work of a more general character, being used for the examination of fuels; the development of specifications for paint products, lubricating and burning oils, boiler compounds, lacquers, plush, car cleaners, cutting compounds, belt dressing, polishing compounds, hydraulic-jack liquids, fuses, track caps, fire-extinguishing preparations; the recovery of used or wasted products, etc.

Certain food products used in the dining car service are also examined here at times; many other miscellaneous investigations are made, as of conditions which may have led to loss from the damage to freight in transit, to establish methods for preventing such loss.

Manufacturing Laboratory

A manufacturing laboratory, which might be called a small factory, is maintained in a separate building which is under the direct supervision of the chief chemist, and new products are manufactured in this until such time as it is found advisable to purchase them from "outside" manufacturers.

Laboratory Car

In addition to the steel-rail work at Altoona, a laboratory car has been built to be moved as required to any

point where steel rails in process of manufacture are to be inspected. This car is equipped for chemical analyses of the finished rails at the mills by a force of chemists under the chief chemist.

There is also a bacteriological laboratory for examining water, which standardizes the disinfectants to be used on the system. It also examines boiler feed water supply and formulates methods for water treatment.

The equipment of the testing plant includes a dynamometer car, a locomotive testing plant, a brake-shoe testing machine, and much other testing machinery.

Extent and Variety of Materials Tested

The scope of the work can be better appreciated when it is understood that the cost of the materials covered by the inspection and tests and entering into the construction of the railroad rolling stock and track, in 1913, amounted to \$92,119,480, while the cost of operating the test department and chemical laboratory for the same year was \$534,060.

PUBLICITY

Most of the railroads of the country are members of the Bureau of Railway News and Statistics. This Bureau publishes reliable statistics on railroad operation, and in fact on practically every subject of interest regarding railroads. For the past six years it has issued annually a volume entitled "The Railway Library" which contains papers and addresses on railroad subjects by prominent publicists, financiers, and railroad officials. It is a presentation in a very convincing and intelligent way of the railroad view on rates, finances, regulation, and such subjects as are of general public interest and discussion.

In regard to the publicity departments of railroads,

Interstate Commerce Commissioner Prouty once said, "It is not only the right but the duty of the railways to present these matters (statistical arguments) to the public from their viewpoint, provided it is done with scrupulous accuracy in the statement of facts." Certainly no fault can be found with the presentation of statistics as made by the Bureau, on the ground of inaccuracy, as its figures check the very complete statistics of the Interstate Commerce Commission, and the analysis of them is carried beyond the Commission's statistics as to many features.

Many of the railroads maintain publicity departments of their own to keep the public advised of transportation news of interest to it and to present their viewpoint on railroad matters being generally discussed by the public. Often the dangers and fallacies in proposed laws, such as the full-crew law, and the railway mail pay, must be presented forcibly to the public to enlist its support in defeating them, and the publicity departments of railroads are the medium through which the public is reached in such matters.

POLICING

All large systems maintain a force of special agents or police. The organization is much the same as any other designed for the protection of persons and property.

The most common offenses for which arrests are made are train-riding by persons not paying fares; trespass on railroad right of way; robbery of cars and buildings; petit larceny, such as removing car brasses, air hose, etc.; intoxication and disorderly conduct on trains and in passenger stations; and willful destruction of railroad property, such as the stoning of trains by boys and malicious persons.

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Special agents are usually appointed by and report to the general superintendent. The number employed depends on the size of the system and local conditions at large terminal freight houses and yards and passenger terminals.

CAR ACCOUNTING, CAR DISTRIBUTION, FAST FREIGHT

The officer actually in charge of car movements is variously called superintendent of car service, car accountant, or superintendent of transportation. In some instances the superintendent of transportation has an assistant who is a car accountant, and there are various titles and arrangements for covering the work, as shown in preceding pages.

Car Accounting

The work to be performed by the car accountant consists of keeping a record at all times of all the freight cars on the line of the company. There are two objects in view: first, to advise the general manager or superintendent of transportation as to the exact location and distribution of all the cars on the company's lines; second, the determination of the rental charges payable by the company for the use of foreign equipment and of the rentals due to it from other companies. To accomplish this, the record must show the initials of the owning company and the number of each car, the time when it arrives on the tracks of the company, and the time at which it leaves such tracks. The actual collecting of the information as to car movement is a work involving much detail and the employment of many men, but the principles involved are those stated above.

In the earlier history of railroads, the rental for the use of cars was based on the mileage of loaded cars.

In the seventies this charge was $1\frac{1}{2}$ cents per mile for loaded cars, and nothing for empties; subsequently this rate was on ordinary cars reduced to $\frac{3}{4}$ cent and finally to 6 mills for all mileage both loaded and empty. After 1902 the system of a per diem charge was adopted; that is, a certain rate per day for the car while in the service of a company other than its owner. (The present rate is 45 cents per day.) Rules providing in great detail for the accounting and for the movement of the cars when on foreign lines have been adopted, the general purpose of which is to facilitate such accounting and use.

The actual performance of the work of accounting for the cars is simple, involving the employment of men at all junctions and connections with other railroads, and a report daily by the station agents of the home company. These reports are made at about 4 o'clock in the afternoon, and are forwarded by wire through the dispatcher to the car accounting officer.

Car Distribution

During normal times and particularly when business is brisk, the subject of car distribution is a very important one to the operating department. It often happens on a large system that one portion of the line may have a surplus of cars and another a shortage, and it requires much skill to effect an economical distribution of cars at all times.

The general object is to provide a car for a shipper within a *reasonable* time after it is requested. It is often not possible, nor would it be always wise, to furnish cars to each shipper requesting them immediately on receipt of his requisition therefor. The inevitable result in many instances of such a process would be the blockading of tracks at all important terminals in the

case of such commodities as grain and coal, and overloading the handling and storage capacities of elevators and other industrial plants.

The principle underlying efficient car distribution is the avoidance as far as possible of empty car mileage. Car distribution is dependent on the nature of the commodities and the geographical situation of the railroad. The movement of such commodities as coal and ore is simpler than the movement of agricultural products, such as wheat, corn, and hay; distribution is less complex on a system which is made up in large part of main line than on one which has a large percentage of branch line mileage.

All cars for shipments should be ordered through the station agent, who reports such requests, together with cars that are loading, or loaded at his station ready for shipment, to the dispatcher, who in turn reports as to the whole division to the superintendent of transportation, or other officer charged with car distribution.

Seasonal demands for certain classes of cars must be anticipated by an accumulation of cars in advance of actual use. The movement of vegetables from the South in the early spring and of grain from the West in the fall are instances of such demands. A knowledge of crop and market conditions is essential to the making in advance of an intelligent estimate of the amount of equipment that will probably be required.

The coal traffic between the mines and large manufacturing centers, such as St. Louis, Chicago, Pittsburgh, and Cleveland, involves the use of an immense number of cars. It is not possible to determine, even a few hours in advance, the number of coal cars that will be released at one of these large centers at the end of the day, and a fair distribution of cars among mines, many on isolated branch lines, is difficult.

The nature and direction of traffic must also be con-

sidered. While lumber, heavy machinery, etc. may be more conveniently loaded on flat cars, if the shipment is destined to a section whose return shipments are largely grain or other agricultural products, it is well, if possible, to ship the lumber or machinery in box cars rather than flat cars to avoid the empty mileage of the flat cars returning. It would evidently be uneconomical to furnish an 80,000-pound car on a request for a shipment of 20,000 pounds of merchandise, and equally so if small capacity cars were supplied for a shipment of a large amount of grain, aggregating several or many carloads, which should move in 80,000-pound grain cars. Such matters, while seemingly simple, require most careful supervision and regulation, which the superintendent of transportation or a similar officer supplies.

Fast-Freight Movement

There are three main divisions of freight traffic which affect the operating department: fast freight, time freight, and ordinary freight.

Perishable goods, such as fresh meats, dairy products, tropical fruits, vegetables, poultry, and certain merchandise, are fast-freight commodities; high-class merchandise, such as sugar, coffee, canned goods, machinery, etc., are time freight; lumber, coal, ore, sand, stone, and such commodities are ordinary freight. Agents are supplied with instructions as to the classification of each commodity and they way-bill shipments in accordance therewith. Way-bills for fast freight should be of a distinctive color.

The cars carrying fast freight are usually designated by a small card attached by the yard clerk so that they may be readily distinguished and given preference. These distinguishing way-bills and cards give such cars

individual identity and facilitate their prompt movement and easy tracing.

Fast freight is moved in trains scheduled frequently at over twenty miles per hour; time freight in trains scheduled at from twelve to fifteen miles per hour. In case a fast or time freight car is set out for any reason, its way-bill must be left at the station with the car. If the agent should overlook the character of the car, the switchman will hardly do so on account of the distinguishing color of the card attached to the car. At the end of a division, should the yard master overlook such a car in making up his train, the yard clerk in giving conductors their way-bills will notice the special way-bills on account of their color and thus check the yard-master.

On interline shipments the yard clerk of the home line furnishes his superintendent of transportation with the way-bill numbers of all cars turned over to each connecting line. The yard clerks of the foreign road will telegraph the superintendent of transportation of the home road, giving the time of arrival and departure at division points of all trains carrying fast-freight cars together with the home road's way-bill numbers, so that the superintendent of transportation is advised at all times of the location of such freight.

In case any fast freight car is set out between division points for any reason, he is also advised by wire by the conductor of the train; should the conductor fail to advise him, the report of the division yard clerk next beyond will disclose the fact. In such instances the superintendent of transportation wires the trainmaster of the particular division on the foreign road to have the car repaired and got to the next division point in a slow train, where it is picked up by the next scheduled fast-freight train. This system of foreign line tracing

also affords a check on the running time of fast-freight trains on foreign lines.

EDUCATION

Some of the railroads have realized the importance of educating their younger employees for better positions in various departments. The education of apprentices in the mechanical department has been undertaken by several of the large systems. A description¹ of the system employed on the Illinois Central and Central of Georgia Railways will serve to show the character of instruction given.

There are daily thirty-minute sessions beginning at 7:00 a. m., which allows ten classes each morning. This large number of classes reduces the apprentices in each class to such small numbers that the instruction is practically individual.

No mechanical drawing is taught in the apprentice schools during the first year and a half to two years. It is the aim to make shopmen, not draftsmen. The apprentice boy needs to learn to read working drawings and to make a shop sketch quickly and accurately, but he need not learn mechanical drawing to accomplish this. The first work consists of eighty-five half-hour lessons on reading working drawings, the thirty-sixth lesson being an actual shop blueprint. These lessons are given on alternate days, or three times a week, and are followed by shop sketching lessons, of which there are sixty. At the end of the one-hundred-forty-fifth lesson the apprentice can read any shop drawing and make any shop sketch necessary.

Following these two subjects is shop practice, varied according to the different trades apprentices are learn-

¹ Abstracted from an article in the *Railway Age Gazette, Mechanical Edition*, LXXXVII 249.

ing. The alternate days not given to the course of lessons first described are assigned to the study of arithmetic and general mechanical subjects. The first year's lessons are in addition, subtraction, multiplication, and division. These lessons are continued through decimals, square root, cube root, geometry, and trigonometry. The last half of the last year the apprentice may take mechanical drawing if he desires. The apprentice period is usually three to four years.

The classroom work and shop instruction are not connected with each other, the one being controlled by the educational bureau and the other by the mechanical department officials.

Since first inaugurated on the systems named, the educational bureau has enlarged its scope and offers its services to employees of all roads, a fee of \$1.00 per month being charged each employee for the service. Its work has been extended to many roads in the Southwest and in the Central States.

The bureau offers courses in the following subjects: Air brake, locomotive, mechanical drawing, machine design, mechanical engineering, gas engine, shop practice, tool making, pipe fitting, plumbing, railroad operation, block signals, interlocking, station work, refrigeration, traffic, track work, concrete, surveying, mapping, mathematics, electrical engineering, sheet metal patterns, drafting, and boiler layout work.

Various roads have methods for instructing employees of the various departments. Nearly all railroads have cars fitted up to demonstrate the construction and proper use of air brakes, the cars traveling over the entire system constantly to instruct all trainmen in their proper use. The Northern Pacific has a traveling fuel car which travels over the system, teaching firemen the theory of combustion and the application of it to practical operation. The Pennsylvania provides lectures, apparatus,

and models for instructing its employees at various points on the system on the following subjects: air brakes, steam heating, valve motion, lubrication, injectors, signals and switches, locomotive firing, and first aid to injured.

Some of the railroads are beginning to realize that traffic employees and station agents and clerks must be trained in traffic matters to avoid the very considerable losses which are incurred in railroad operation through lack of proper interpretation of tariffs by railroad employees. Tariffs, classifications, rules and regulations, exceptions and other matters have become so complicated to the uninstructed that special training is required along those lines and is as necessary in the traffic as in the mechanical or operating departments.

RELIEF

In most of the brotherhoods of railway employees, insurance is compulsory, being a condition of membership. The officers of the national organization manage the funds contributed by members and are subject to the control of the annual convention of the members.

The Brotherhood of Locomotive Engineers in 1914 had in force insurance to the aggregate amount of \$150,000,000. Since 1867 it has disbursed \$30,000,000 in death and disability claims. In May 1915 the Brotherhood of Firemen had an aggregate insurance fund of \$4,133,135, and during the year ended June 1, 1915, has disbursed \$980,000 from its funds for death and disability benefits.

Some of the railroads have organized relief departments in which all employees may participate. The funds are managed usually by an advisory committee appointed jointly by the directors of the railroad com-

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pany and the several classes of employees. There are generally several classes of membership based on the monthly earnings of the employee.

On the Atlantic Coast Line there are five classes of members paying monthly from \$0.75 to \$3.75, for which they receive the following benefits:

Accident benefits—Free surgical attendance and payments ranging from \$0.50 to \$2.50 daily for a period of one year, and one-half these amounts for periods greater than one year.

Sick benefits—At the same rates as for accidents.

Death benefits—Ranging from \$2.50 to \$1250.

PENSIONS

The first railroad pension department was established by the Baltimore & Ohio in 1889. Since that time many of the large systems have inaugurated some kind of pension department. A description of that of the Pennsylvania Railroad, abstracted from a general notice issued by Mr. A. J. Cassatt, president in 1899, will serve to show the general plan of railroad pension departments.

1. All officers and employees of the company, giving their entire time to its service, who have attained the age of seventy years; or who, being between the ages of 65 and 69 years, shall have been 30 years or more in company's service and shall then be physically disqualified, shall be relieved and placed on the pension roll.

2. Subject to ratable reduction, so that the entire pension expenditure shall not exceed the sum of \$300,000 annually, pensions shall be allowed on the following basis:

3. For each year of service one per cent of the average regular monthly pay for the ten years preceding retirement. To illustrate: An employee in the service forty years receiving an average monthly wage of \$40

for the last ten years would receive a pension allowance of forty per cent of \$40 or \$16 per month.

4. Pension allowances are paid monthly and terminate on the death of the employee.

5. No pension allowance is paid during the period when the employee is receiving benefits from the relief department.

6. Acceptance of pension shall not debar employee from engaging in other business, but such a person cannot re-enter the company's service.

7. The pension department is under the supervision of a vice president, the general manager, and the assistant comptroller of the company. The board of directors may appoint members of such pension board at any annual meeting.

No person over thirty-five years of age is taken into the service of the company except that with the approval of the board of directors (1) former employees may be re-employed within a period of three years from the time of their leaving company service; (2) persons may be employed, irrespective of age, where service for which they are needed requires professional or other special qualifications; (3) persons may be employed temporarily for a period not exceeding six months, subject to extension when necessary to complete the work for which they are engaged.

PURCHASING DEPARTMENT

The duty of the purchasing department is to supply material required by various departments in such quantity and of such quality as they specify and to do it in the shortest possible time and at the least cost.

There are many advantages to be gained in concentrating purchasing power in one department. Having general advance information of the requirements of all

departments for the year, it may order many classes of material in large quantities and in consequence obtain them at lower prices. Uniform specifications, for many general classes of material, facilitate inspection and so improve the quality of material. Further, the records of the department soon afford the means for establishing cost data, which is very essential in forming a judgment as to the fairness of prices asked on similar material.

Usually rail and equipment purchases are not made by the purchasing department, the executive department attending to such large matters.

The purchasing agent is usually assisted by a fuel agent, a tie-inspector, a stationer, and a general storekeeper.

The cost of fuel is greater than that of any other single item of railroad expense. The fuel agent supervises the inspection, loading, and shipping, and in a general way the accounting for fuel purchased, and is advised generally as to conditions of the fuel market.

The tie-inspectors inspect all ties delivered and classify them under the specifications as first-class, second-class, or culls. All large purchases of lumber are inspected and classified.

The stationery-store stock is a supply of all the numerous blank forms, stationery, and other office supplies. It is in charge of the stationer, who issues it on monthly requisitions from the various departments and from general division and agents' offices. The requisitions from the last named are usually supervised by the traveling auditors.

The stores department is under the direct supervision of the general storekeeper, and the records of all material purchased for it are kept by him. While much of the material purchased is not delivered to the store-

house, being shipped direct to point of use on the line, the storekeeper keeps a record of all of it.

Such material as lumber and hardware must be kept on hand at all times to be issued to various departments, usually in small amounts, on properly approved requisitions. This stock is replenished from time to time by the purchasing agent on requisition from the storekeeper. The general aim in the stores department is to have as little money tied up in stock as possible without embarrassing the departments requiring it by undue delays in filling requisitions. This supervision, especially on large lines, is very important on account of the large amount of material and supplies required to be kept on hand. On the Santa Fe System this item was on June 30, 1915, \$15,870,460.48.

Semi-annual inventories of stock are taken as a check on the record of purchases and requisitions with the purpose of showing the disposition of all purchases and the proper division of cost to each department.

The department is also charged with the sale of old material unsuitable for railroad use, such as scrap iron, steel, rubber, and old equipment which through obsolescence or age can no longer be economically used.

The head of the department of purchases and stores is one of the three vice presidents reporting to the president and has an assistant. The purchasing and stores divisions are sharply distinguished, the former being in charge of a general purchasing agent and the latter under a general storekeeper. There are two assistant purchasing agents on lines East of Albuquerque, two purchasing agents on the Coast Lines, and a coal-inspector and tie-inspector in the purchasing department.

CHAPTER XIX

EXAMPLES OF TYPICAL ORGANIZATIONS

Having shown the organization and activities of the respective departments of various railroads, we may now consider them collectively, and for this purpose a small line, the Manistee & Northeastern Railroad, and a large system, the Atchison, Topeka & Santa Fe Railway, have been selected.

All systems of railroad have been created through the combination of small individual local roads, most of which, from financial necessity, were built a few miles at a time. By far the greater number of these original small roads have been consolidated into small systems by purchase, stock control, or lease and the small systems in turn into large systems.

MANISTEE & NORTHEASTERN RAILROAD

For the purpose of illustrating the organization of a small railroad the Manistee & Northeastern Railroad has been selected. This line is an excellent example of a small, independent, well-managed railroad, in which the supervision of more than one department is in the hands of one official. Such officials must be "all-around" railroad men, rather than specialists, but it will generally be found that there is one department which particularly engages their attention, the direct supervision of a portion or all of a department of less importance being delegated to an assistant.

The fact that, with average gross earnings (in a

period of five years) of about \$3,000 per mile, it has been able to pay all expenses and add to its surplus practically \$180,000 during a period of business depression speaks well for its organization and management.

This railroad has a main line seventy-one miles long extending from the port of Manistee on Lake Michigan to Traverse City on Grand Traverse Bay in Northern Michigan; a branch seventy-nine miles long from the main line to Grayling; one of fifteen miles to Provemont; and one of seventeen miles to Empire Junction.

The "property operated" statement covering this feature is as follows:

	Miles	Miles	Miles
Main line	70.76	.....	.....
Branches	111.80	182.56	.....
Sidings and spurs .....	.....	52.89	.....
Total trackage owned .....	.....	.....	235.45
Leased lines .....	.....	.....	1.26
Lines operated under contract .....	.....	.....	6.00
<hr/>			
Total mileage operated ....	.....	.....	242.71
Total main line and branches			
operated .....	.....	.....	189.82

Its equipment consists of sixteen locomotives (of locomotives weighing more than forty tons); nine coaches; five combination cars; two baggage, mail, and express cars; 748 freight cars (of which forty-two are refrigerator cars); two snow plows; one steam shovel; two boarding cars.

It connects with the Michigan Central Railroad, Pere Marquette Railroad, Grand Rapids & Indiana Railway, Ann Arbor Railroad, and three small branch roads, and with lake steamers at Manistee.

Its operating ratio in 1914 was about seventy-six per cent, and in 1915 eighty-two per cent. The average for

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twenty years has been 67.5 per cent. Abnormal conditions in market prices of fruit, potatoes, and lumber, the carrying of which commodities furnishes an important part of its revenue, explains the decrease in net earnings. Its funded debt (interest-bearing securities) is \$1,291,000 and its capital stock \$2,000,000.

Operation

The cost of maintenance of way in 1915 was \$354 per mile of line operated. The cost of maintenance of equipment was (average) per locomotive, \$1,800; per passenger car, \$320; per freight car, \$70.

Its passenger earnings per mile of road were \$519; per train mile, \$0.60; its freight earnings per mile of road were \$1,900; per train mile, \$2.07.

The organization of the road is shown in Figure 28.

The general manager, who is also vice president, reports to the president and board of directors. Reporting to him are the general superintendent, superintendent, chief engineer, traffic manager, and auditor.

The general superintendent is also purchasing agent, and has charge of the shops, station agents, and dispatching service. The superintendent of motive power, dispatcher, and station agents report to him. His duties, therefore, are supervision of maintenance of equipment and purchasing, with a part of the transportation.

The superintendent has charge of all train movements and the maintenance of the roadway, having a roadmaster to assist him by direct supervision of the track forces. His supervision is therefore over a portion of transportation and a large part of maintenance of way.

The chief engineer has charge of the design and construction of all new work, the maintenance of all bridge structures, and all matters pertaining to the right of way

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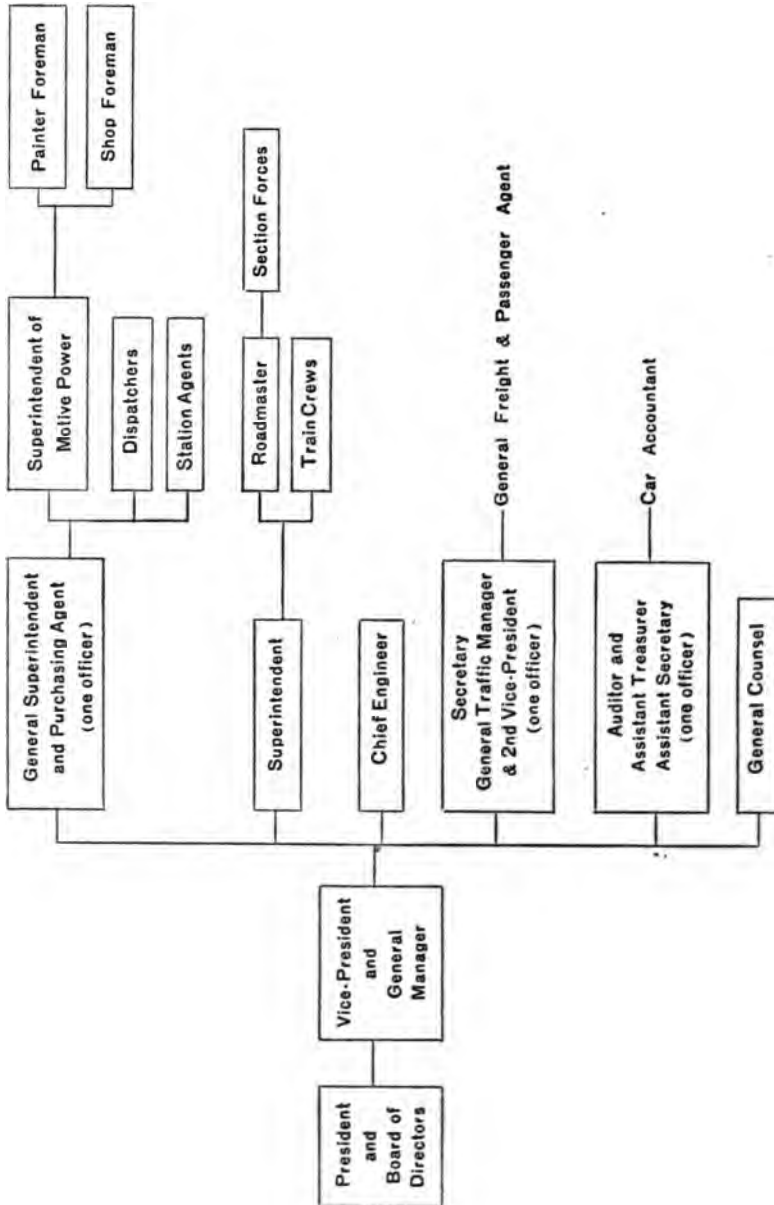


FIG. 28.—Organization of the Manistee & Northeastern Railroad

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and other lands of the company. His supervision is of construction, real estate, and a portion of maintenance of way.

The traffic manager, who is also the secretary and second vice president, has supervision of all traffic matters, having a general freight and passenger agent in direct charge of traffic matters. His duties, therefore, relate both to the traffic and the executive departments.

The auditor, who is also assistant secretary and assistant treasurer, has full charge of the accounting, with a car accountant reporting to him, being in consequence an accounting and operating official.

All these officers are located at the company's headquarters in Manistee, Mich. The general counsel, retained to look after the legal affairs of the company, is located at Grand Rapids.

ATCHISON, TOPEKA & SANTA FE SYSTEM

This system has a total mileage of 11,136.43 miles and extends from Chicago through Kansas City to San Francisco, Los Angeles, and San Diego on the Pacific Coast, Galveston on the Gulf of Mexico, El Paso on the Rio Grande, and Denver in the Rocky Mountains, reaching practically every city of importance in the Southwest. It has important systems of lines in Texas, Arizona, and New Mexico, and many branches in Nebraska, Kansas, Colorado, and Oklahoma.

Its total capitalization for 11,022.35 miles of its system June 30, 1915, was \$625,000,000 in round numbers, or at the rate of \$57,000 per mile, divided about evenly between funded debt and stock, the stock being owned by more than 43,000 shareholders. Its gross revenue per mile was \$10,856.32 and its net income \$3,321.47. The operating ratio was 64.67 per cent. Its dividend rate on common stock for the past years has been 6 per

cent annually. It underwent a drastic reorganization in 1896, which in connection with its excellent administration since, accounts for its healthful financial condition. Its organization is therefore an interesting study, as the dividend available after all fixed charges and earnings have been paid is the final test of any organization.

The organization chart is of the Atchison, Topeka & Santa Fe Railway Company only and does not include the Gulf, Colorado & Santa Fe Railway and other lines in Texas which are a part of the parent system.

The chairman of the executive committee, located in New York, is also general counsel, and he and the president, located in Chicago, report directly to the executive committee. The president has an assistant in Chicago and one in San Francisco.

Financial

The comptroller reports to the president. He is located in New York and is the financial representative of the company in the East. He attends to the disbursement of interest on bonds and other obligations and dividends on stock, and also supervises the transfer of stock in New York. He receives money from the treasurer at Topeka and the assistant treasurer at Los Angeles, but those officers do not report to him in other matters. He attends also to the delivery of securities. He is not connected with the accounting department in any way, the head of that department, the general auditor, reporting to the president direct. He is assisted in the duties mentioned by a deputy comptroller, who acts for him in his absence; an assistant secretary who attends to the transfers of stock and other secretarial duties; and an assistant treasurer in the receiving and banking of

remittances from the treasurer and western assistant treasurer.

The secretary and treasurer is located at Topeka, Kan., with an assistant treasurer, two cashiers, a paymaster, and an assistant paymaster on his staff. He receives the remittances of station agents and other revenue-collecting employees and the payments for bills and settlements arising from the operation of the Atchison, Topeka & Santa Fe Railway east of Albuquerque and is paymaster for that portion of the system. He reports to the president.

The western assistant secretary and treasurer located at Los Angeles, Cal., with a cashier and paymaster assisting, performs the same functions for the Coast Lines, Atchison, Topeka & Santa Fe Railway west of Albuquerque. This western assistant and the treasurer report to the president direct.

It will be noted that this financial organization avoids much of the usual circumlocution; the several officers, located in widely separated centers, report to the president direct. All large systems must have a responsible financial representative, with some diplomatic ability, in close touch at all times with the large banking interests, in New York, and the comptroller fulfills this requirement. The detail financial work of the treasury department requires that the headquarters organization be located close to the center of operation. The distance between the eastern and western termini of the system is so great that close supervision may not be had with one organization. In consequence the treasurer is located at about the center of the Lines East of Albuquerque, and the western assistant treasurer, who is in effect treasurer of the Coast Lines, is located as nearly as practicable at the center of operations west of Albuquerque. The secretary at Topeka with assistants at both the western termini of the system and New York pro-

vides a means for attending to secretarial matters without delay.

Legal

The general and assistant general solicitors are located in Chicago. Reporting to the assistant general solicitor are the western solicitor, the general attorney located in Chicago, and the general claim agent located in Topeka, Kan. Three attorneys in Chicago, one attorney for the Coast Lines, and seven state solicitors report on various matters to the assistant solicitor, the western solicitor, and the general attorney. The state solicitors have assistant solicitors and attorneys and local attorneys, with a special counsel for Kansas reporting to them.

That is, there is a general headquarters staff in the legal department at Chicago with an attorney on the Coast Lines in special charge of matters pertaining to it, and a solicitor in each state with assistants, attorneys, and local attorneys at county seats, reporting to them.

The general claim agent, with an assistant and claim adjusters, is located at Topeka, and a claim agent, with assistant and adjusters, is located at Los Angeles, the Topeka organization attending to claims on the Lines East of Albuquerque and the Los Angeles organization to those on the Lines West of Albuquerque.

These organizations adjust both personal injury and loss and damage claims, the overcharge claims being cared for by the accounting department.

Operating and Construction

The vice president in charge of operation is also in charge of all construction. The organization of the operating department has already been described in the chapter on operation and will not be treated here. It is unusual to find one vice president in charge of two

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departments of a railroad involving such large responsibilities as supervision of operation and construction, the first being considered a large enough task for almost any one man. That such combination of supervision is made at times serves to illustrate the fact that the personalities of officers, their previous training, and the exigencies of the service have a marked effect in all large organizations.

The present vice president in charge of both departments was formerly the vice president in charge of construction when the system was pursuing a policy of extensive improvements, betterments, reconstruction, and extension of lines and facilities. Much of this work was completed when a vacancy at the head of the operating department promoted him to that position and his previous connection with construction matters, and the decreased work in connection therewith, suggested the adding of general supervision of his former work to his new duties.

Traffic and Purchasing

This organization has been already discussed in the chapter on the traffic department. It is to be noted from the diagram that the management of mail traffic is under the supervision of a manager reporting direct to the vice president in charge of traffic instead of being handled by the general baggage agent, which is the arrangement generally followed by western roads.

The purchasing department organization is discussed in the description of that department in the Miscellaneous chapter.

Accounting

The general auditor reports direct to the president and not through the comptroller as he does in most

organizations. There are four auditors and one traveling accountant reporting to him. For the Lines East of Albuquerque there are an auditor of disbursements with ten traveling accountants, a freight auditor with thirteen traveling auditors, and a ticket auditor (passenger traffic) with an assistant. The auditor of the Coast Lines—West of Albuquerque—audits disbursements as well as freight and passenger accounts, having an assistant, four traveling accountants, and four traveling auditors on his staff.

Miscellaneous

The land commissioner has charge of land grant real estate, all of which is located west of Albuquerque. The work involved is the selling and leasing and protecting the property against trespass. Such work necessitates the making of deeds, leases, and agreements and the collection of rentals due under such leases. This commissioner reports direct to the president.

The statistician reports to the president and is a very important officer on this system. The statistics are not compiled in the usual way, but they are interpreted and arranged for practical commercial purposes. Statistics are compiled for the operating and traffic departments for the purpose of saving money in the operating and making money (increasing revenue) in the traffic.

The traffic statistics have especial consideration. On this road these abstracts (agents' abstracts of way-bills) are, by the carbon process, made in duplicate and a copy is sent by every agent to the statistical department, thereby giving to it the record of all traffic movements. In this department is prepared, from these

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abstracts, what is known as a "monthly commodity unit," which represents in a single item the movement of every separate commodity between any two stations on the line, showing origin, destination, weight, ton miles, and earnings. The abstracts are then filed in calendar order by stations, the monthly units, after being aggregated in certain general ways, being filed by commodities. We thus not only have at hand in statistical form the information ordinarily wanted, but are prepared to furnish almost immediately upon call any information that may be desired.

A complete record of the performance, expenses, and repairs of each individual locomotive is also kept in this department, by which the relative cost per ton hauled of each locomotive or class of locomotives can be ascertained. A record is also kept of tonnage hauled by trains on each train district as well as the tonnage loading by individual cars at all stations.

These statistics are used by the traffic department in the practical solution of many traffic problems. The department is also used to check the actual movement of certain freight and to determine if shippers are diverting a portion of it after arrangements have been made for certain quantities. The department can also furnish a statement of the extent of the business done by large shippers.

Its statistics show actual earnings per ton mile on each separate commodity, which in connection with the average distance, loading, and total tonnage of each commodity, forms a basis for intelligent judgment as to the relative profitableness of carrying various commodities.

The commissioner of taxes, with a tax commissioner for the Eastern Lines and a tax agent for the Coast Lines, gives his entire attention to the matter of various state assessment of taxes.

There are a manager of insurance, a secretary of the board of pensions, and a publicity agent, all reporting to the president. Their duties are the usual ones assigned to such departments, a description of which will be found in the chapter on Miscellaneous Departments.

The manager of station advertising, as his title indicates, looks after all matters pertaining to advertisements posted in the stations of the company. The applications for permission to display advertisements are many and come from widely different sources, some of which might well be positively objectionable, and all of them require investigation to determine their suitability and to limit the quantity to be displayed.

CONCLUSION

The great value of railway transportation is patent to all thinking men. No other agency benefits a community, enhances values, and promotes civilization to the extent that is done by common carriers. The prosperity of large communities, of states, even of the nation, depends upon the ability of the railroads to render efficient service.

As opposed to government ownership there is the alternative of consolidation, the merging of many independent lines and systems into several major organizations, which to a great majority seems preferable. The advantage to be derived is a larger and more stable organization independent of all risks and vicissitudes, permitting the more economical transaction of business. The uniformity of practice, standardization of equipment, material reduction in employees, especially of the executive type, the elimination of duplication of records, and the like will contribute to decreased operating

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expense with the result that transportation charges to the public may likewise be reduced.

It seems to one who studies the organization and service of common carriers throughout the United States, that the larger the system the more efficient and orderly the service. The larger systems in the country, are rendering a service that is without parallel the world over, due, in a great measure, to efficient administration. The small organizations leave much to be desired in this regard.

TEST QUESTIONS

These questions are for the student to use in testing his knowledge of the assignment. The answers are not to be sent to the University.

1. What are the most important duties of the freight traffic department?
2. What reports are furnished traffic departments by their agents?
3. What determines the character of the service rendered?
4. Is uniformity of service more essential than speed?
5. What are the duties of the freight traffic manager?
6. What data are compiled by the rate statistical department?
7. How is a division freight agent distinguished from a general agent?
8. What are the duties of European freight agents?
9. Outline the freight traffic department organization of the Atchison, Topeka & Santa Fe.
10. With what is the tariff bureau concerned?
11. What are association meetings?
12. What division of traffic department supervises the handling of milk and express?
13. What is the average revenue from passenger train service as a whole?
14. Are passenger trains operated always with the idea of present profits?
15. What are the duties of the passenger traffic manager?
16. Summarize the organization of the passenger department of the Chicago, Burlington & Quincy.
17. What are the activities of the immigration agent?
18. Why is there no incentive for the selling agent?
19. What is the most important single feature of railway advertising?
20. What is the largest railway passenger association?
21. What are the functions of the freight claim department?
22. Into what classes may freight claims be divided?
23. What are the duties of the voucher clerk?

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24. How is the industrial bureau related to the traffic department?

25. How may the purchasing department be utilized from the traffic standpoint?

26. What is the purpose of the Central Freight Association?

27. What is meant by a standing committee?

28. What are information circulars?

29. In the early days how were railway accounts maintained?

30. What are the general functions of the accounting department?

31. What are the duties of a comptroller?

32. Into what classes may auditors be divided?

33. What are disbursements?

34. What accounts fall under the jurisdiction of the auditor of merchandise?

35. Summarize the activity of the department of real estate and taxes.

36. How is insurance on company property usually effected?

37. What advantage is gained by the establishment of a testing department?

38. For what reasons are lamp tests made?

39. Why is it desirable for the railways to maintain publicity departments?

40. For what offenses are arrests usually made as concerns transportation?

41. What is meant by the term car accounting?

42. How is car distribution usually affected?

43. What advantage is gained by the inauguration of fast freight schedules?

44. Summarize the educational plan involving the Illinois Central Railway.

45. What is the range of death benefits?

46. What is the requirement of the pension department of the Baltimore & Ohio respecting pensions to superannuated employees?

47. What were the passenger earnings per mile of road for the Manistee & Northeastern Railway?

48. What is the total mileage of the Santa Fe System?

49. Does the vice president in charge of operation have charge of construction matters as well?

50. What are the duties of a land commissioner?

51. With what is the manager of station advertising concerned?

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